PROCEEDINGS

Fifty-Fourth Annual Convention

OF THE

American Railway
Bridge and Building Association

1949

Digitized by the Internet Archive
in 2011 with funding from
University of Illinois Urbana-Champaign

http://www.archive.org/details/proceedingsofann54amer

Proceedings of the

Fifty-Fourth Annual Convention

OF THE

American Railway
Bridge and Building
Association

Held at

CHICAGO, ILLINOIS

September 12-14, 1949

Published by the Association
Elise LaChance, Secretary
431 So. Dearborn St., Chicago

CARL GORR PRINTING COMPANY
1801 W. BYRON ST. - CHICAGO

OFFICERS FOR 1949

E. H. Barnhart Baltimore & Ohio, Garrett, Ind.	President
W. F. Martens Atchison, Topeka & Santa Fe, San Bernardino, Calif.	First Vice-President
W. A. Huckstep Missouri Pacific, St. Louis, Mo.	Second Vice-President
Guy E. Martin Illinois Central, Chicago	Third Vice-President
F. R. Spofford Boston & Maine, Dover, N. H.	Fourth Vice-President
Elise LaChance 431 S. Dearborn, Chicago	Secretary
L. C. Winkelhaus Chicago & North Western, Chicago	Treasurer

The Executive Committee Consists of the Officers and the Following

DIRECTORS

Terms Expire 1949

Lee Mayfield, Missouri Pacific	Houston, Texas
F. M. Misch, Southern Pacific	San Francisco, Calif.
W. D. Gibson, Chicago, Burlington & Quincy	Chicago

Terms Expire 1950

H. M. Harlow, Chesapeake & Ohio	Richmond, Va.
V. E. Engman, Chicago, Milwaukee, St. Paul & Pacific	Savanna, Ill.
G. W. Benson, Central of Georgia	Macon, Ga.

Past-President

J. S. Hancock, Detroit, Toledo & Ironton	Dearborn, Mich.

OFFICERS FOR 1950

W. F. Martens Atchison, Topeka & Santa Fe, San Bernardino, Cal.	President
W. A. Huckstep Missouri Pacific, St. Louis Mo.	First Vice-President
Guy E. Martin Illinois Central, Chicago	Second Vice-President
F. R. Spofford Boston & Maine, Dover, N. H.	Third Vice-President
Lee Mayfield Missouri Pacific, Houston, Tex.	Fourth Vice-President
Elise LaChance 431 S. Dearborn, Chicago	Secretary
L. C. Winkelhaus Chicago & North Western, Chicago	Treasurer

The Executive Committee Consists of the Officers and the Following

DIRECTORS

Terms Expire 1950

H. M. Harlow, Chesapeake & Ohio	Richmond, Va.
V. E. Engman, Chicago, Milwaukee, St. Paul & Pacific	Savanna, Ill.
G. W. Benson, Central of Georgia	Macon, Ga.

Terms Expire 1951

F. M. Misch, Southern Pacific	San Francisco, Cal.
L. R. Morgan, New York Central	Detroit, Mich.
J. A. Jorlett, Pennsylvania	New York

Past President

E. H. Barnhart, Baltimore & Ohio	Garrett, Ind.

TABLE OF CONTENTS

Page
Running Story of Convention 5
Election of Officers 6

Abstract of Addresses by:

President E. H. Barnhart 5
J. H. Aydelott 6
C. J. Geyer 7
C. M. Kimball 7
F. S. Schwinn 7
Report of Treasurer 8
Report of Secretary 9
List of Past Officers Since Organization 38
Constitution and By-Laws 44

Directory of Members:

Active Members 56
Life Members 70
Charter Members 76
Honorary Members 76
Associate Members 76
Membership by Roads 84
List of Advertisers 97

Committee Reports

Disposal of Liquid Waste at Engine Terminals 10
Methods and Material for Fire Protection for Bridges and Trestles 14
Pier Construction and Maintenance of Waterfront Terminals 17
Methods of Prevention and Removal of Corrosion from Steel Structures 21
Installation and Maintenance of Built-Up Composition Roofing 24
Prolonging the Life of Ties on Bridges and Trestles 29
Developments in Modern Methods for Watering Passenger Coaches 32
Safety in Transportation of Men and Materials 35

PROCEEDINGS

This section contains a running story of the activities during the three-day annual meeting in 1949; brief abstracts of the addresses read to the joint sessions with the Roadmasters' Association; and all of the B. & B. committee reports, printed in full, with brief abstracts of the discussions that followed their presentation.

NEW WAYS are constantly being developed to deal with existing problems in the maintenance of railway structures, and new problems are constantly arising to challenge the ingenuity of bridge and building supervisors. The truth of these two observations was emphasized time and again during the presentation of eight technical committee reports before the fifty-fourth annual convention of the American Railway Bridge & Building Association, which was held at the Stevens hotel, Chicago, September 12-14, 1949.

The Bridge & Building convention, for the fourth consecutive year, was held concurrently under the same roof with the annual meeting of the Roadmasters' and Maintenance of Way Association. The two conventions were convened in a joint session on Monday morning, September 12, which was directed jointly by E. H. Barnhart, division engineer, Baltimore & Ohio, and president of the Bridge & Building Association, and R. L. Fox, division engineer, Southern, and president of the Roadmasters' Association. Mr. Barnhart, assisted by W. F. Martens, supervisor of salvage, Atchison, Topeka & Santa Fe, and first vice-president of the association, presided over the separate sessions of the Bridge & Building group.

The principal address at the joint opening session was delivered by J. H. Aydelott, vice-president, Operations and Maintenance department, Association of American Railroads. At two subsequent joint sessions the two groups heard addresses on the 40-hr. week by F. S. Schwinn, assistant chief engineer, Missouri Pacific lines in Texas and Louisiana, and president of the American Railway Engineering Association; on the subject, What Now? You Can Help, by C. J. Geyer, vice-president, construction and maintenance, Chesapeake & Ohio; and on Personalizing the Safety Concept, by C. M. Kimball, assistant to vice-president (safety), Southern System. The address by Mr. Schwinn was followed by a panel discussion in which the speakers consisted of C. M. Chumley, engineer maintenance of way, Illinois Central; G. L. Sitton, assistant chief engineer, Southern System; and A. A. Cross, engineer maintenance of way, New York, New Haven & Hartford.

There was no manufacturers exhibit at the conventions this year, but the Track Supply Association and the Bridge & Building Supply Men's Association, the exhibit-sponsoring organizations at these meetings, collaborated in putting on display in the corridor of the convention floor the photographic exhibit of railway engineering progress that was originally shown at the Golden Anniversary convention of the A. R. E. A. last March. The exhibit was loaned for this purpose by the National Railway Appliance Association. Also, the Track Supply Association and the Bridge & Building Supply Men's Association gave a banquet on Tuesday evening for the railroad men attending the two conventions, and their families at which 1,000 persons were served.

General speculation in advance of the conventions was that the lack of an exhibit would be reflected in a considerable drop in the attendance as compared with previous years. However, the drop was not nearly as serious as was anticipated in some quarters. A total of 808 members and guests registered at the two meetings. While this was somewhat under the peak registration of 900 members and guests at the 1948 meeting, it was considerably higher than the comparable figures for 1946 and 1947, the other two years during which the two conventions were held concurrently.

An address by President Barnhart was the opening feature of the first separate session of the Bridge & Building group. Confining his remarks largely to the affairs of the association, Mr. Barnhart explained that the practice inaugurated at the 1948 convention of selecting during the meetings the subjects to be studied the following year, permitting early selection of the committee chairmen and members, had proved highly satisfactory. Then, explaining how the active membership of the association has been brought back from a "low ebb" at the close of the war, he presented figures showing that the total membership in the association was 676 on August 31, or 24 members more than on the same date last year.

Following Mr. Barnhart's address the group tackled the principal business of the meeting, which consisted of the presentation and consideration of eight committee reports on the following subjects: Installation and Maintenance of Built-Up Composition Roofs; Safety in Transportation of Men and Materials; Methods and Materials for Fire Protection for Bridges and Trestles; Prolonging the Life of Ties on Bridges and Trestles; Methods of Preventing and Removal of Corrosion from Steel Structures; Disposal of Liquid Waste at Engine Terminals; Modern Methods for Watering Passenger Coaches; and Pier Construction and Maintenance of Waterfront Terminals.

In the election of officers at the final business session Mr. Martens was advanced to president; W. A. Huckstep, general building supervisor, Missouri Pacific, was promoted from second vice-president to first vice-president; Guy E. Martin, superintendent water service, Illinois Central, was advanced from third vice-president to second vice-president; F. R. Spofford, assistant division engineer, Boston & Maine, was promoted from fourth vice-president to third vice-president; Lee Mayfield, resident engineer, Missouri Pacific Lines, Houston, Tex., was elected fourth vice-president; and L. C. Winkelhaus, architectural engineer, Chicago & North Western, was re-elected treasurer. Directors elected were: F. M. Misch, general bridge and building supervisor, Southern Pacific; L. R. Morgan, fire prevention engineer, New York Central; and J. A. Jorlett, assistant engineer, Pennsylvania.

Seven subjects were chosen for investigation by committees during the ensuing year. These are as follows: Types of Treated Lumber and Uses of in Building Maintenance and Construction; Construction and Maintenance of Station Platforms; How to Sell Accident Prevention to the Man in the Gang; Installing and Maintaining Waterproofing on Ballast Deck Bridges; Mechanization and Specialization of Forces; Concrete Piles in Bridge and Pier Construction; External Protection From Corrosion for Pipe Lines.

Abstracts of the addresses by Messrs. Aydelott, Schwinn, Geyer and Kimball, as delivered before the joint sessions, are presented below, followed by the committee reports in full, with brief abstracts of the discussions from the floor.

Must Tell the Public

IN HIS opening address before the joint opening session on Monday, Mr. Aydelott discussed the overall problems of the railroads in dealing with rising costs and in competing with subsidized forms of transportation. Since "so much has been said in the past about the railroads being over-capitalized and over-burdened with debt," Mr. Aydelott pointed out that the financial structure of the railroads has been "vastly improved" since the pre-war years, indicating, he said, that sound managerial policies exist in the railway field.

Mr. Aydelott asked his listeners, in their contacts in home communities to state the case of the railroads, pointing out their accomplishments and the extent to which they contribute to the welfare of the people in the communities served. With forces in this country promoting policies, the adoption of which would eventually destroy the railroads as free institutions, Mr. Aydelott said that the public and its representatives in Congress, and in the state legislatures, should be told that whatever happens to the railroad industry to bring about its nationalization can happen to any of the free institutions in this country, "whether they be in the field of industry, mining, merchandising or farming." He said that the acceptance of subsidies from the federal government is an invitation to government direction and that the long-range effect of subsidies is to pauperize all forms of transportation.

Must Observe Results

Supervision can help in the solution of the railroads' problems if it will take note of the conditions under which work is done and "through the months and years couple the results up with the execution of the job and see if you can figure out better planning," said Mr. Geyer, in his address before the joint session on Tuesday afternoon. The contribution that the two associations have made to the railroad industry, said Mr. Geyer, has been made possible through the efforts of those members who, imbued with a desire to do a good job at low cost, have noted the results of their daily work and, at the annual meetings, "have told others what they have accomplished and listened to the accomplishments of others."

Mr. Geyer drew an analogy between farming and railroad maintenance, and said that the successful farmer or maintenance officer, in the event of a failure, will not be satisfied with the first excuse that comes in mind, "but will review the case history with the intent of finding the real cause of failure and of doing everything in his power to avoid premature failures, extend life cycles, and thereby reduce annual costs." If maintenance policies and plans are well conceived, maintenance officers of supervisory rank, instead of "working on a crisis basis," will become real supervisors instead of mere "trouble shooters."

Mr. Geyer expressed the belief that it is practical and economical to smooth out maintenance work over the years to avoid either heavy or light expenditures in any one year. This policy, he declared, will prolong the life cycles of materials, will permit work to be planned in an orderly manner, and will bring about desirable labor relations because of greater regularity of work. The end result, he said, will be lower maintenance costs and a better and more uniform maintenance condition.

In Mr. Geyer's opinion the 40-hr. week presents no new problem—"it is simply another high cost obstacle that must be overcome." He told his listeners that "you have done an excellent job in overcoming these cost obstacles in the past and you can whip this one if you will review your planning, dust off your old economy studies, and don't forget to look for new ones."

The Careful Survive

"A railroad section is just as dangerous as the foreman permits it to be, and just as safe as management *wants it to be*," stated Mr. Kimball in his address before the joint session on Tuesday afternoon on Personalizing the Safety Concept.

Just as military leaders ride at the front of their columns to obtain an overall strategic concept of conditions, Mr. Kimball said that the leaders on the railroads must place themselves at the forefront, holding Safety First above everything else so that the employees may live in health and happiness. While nature's law is "survival of the fittest," Mr. Kimball said that today's law is "survival of the careful," and we must progress with this in mind.

In concluding his address, Mr. Kimball said that "one of the blessings of today is that not a section laborer or carpenter can be killed without the president of his road knowing about it." He stated that the responsibility for the safe operation of our mechanized appliances and equipment, as well as the safety of the workmen, rests upon the shoulders of the supervisor.

The 40-Hr. Week

Maintaining the railroads in 40 hr. a week is not a problem, but a job that must be done—a job of planning, study and work—said Mr. Schwinn in his address before the joint session on Tuesday morning. Railroad men have all the answers required in performing this job, according to Mr. Schwinn; all that they have to do now is apply them properly.

As the basis for this viewpoint Mr. Schwinn drew an analogy between the present situation involved in reducing the work-week for non-operating employees from 48 to 40 hr. and that which confronted the railroads in 1918 when the work-week was reduced from 60 to 48 hr. Rather than the number of maintenance-of-way employees being increased as a result of that earlier development, Mr. Schwinn pointed out that there was a gradual decrease, which amounted to 35 percent 30 years later. This decrease occurred, he said, in spite of an increase of 70 per cent in the amount of freight traffic carried, and an increase of 40 per cent in train speeds.

This showing was made possible, said the speaker, because of better and more permanent bridges and track, the development of new organizational methods for the employment and distribution of manpower, long strides in the mechanization of maintenance work, the development of means for stabilizing the roadbed, and the general adoption of the creosoted tie. Pointing out how these same expedients can be of help in the present situation, Mr. Schwinn said that "quite likely we can go much further in the performance of work by machines rather than by hand," that there will be other machines developed to perform work which we are still doing by hand, that "we can do very much more" in the stabilization of the roadbed and track, that there are good prospects of securing even greater life from crossties, and that "the use of longer rails with resulting large economies is definitely in the picture of the future."

Saying that railroading under the free enterprise system is founded on economics, and economics supply the urge for most railway activities, Mr. Schwinn added that maintenance men are "facing another economic necessity today." To substantiate this statement he recited figures showing how increased costs and taxes have affected railway earnings. As a consequence, he stated, the economic necessity for reducing costs is actually greater today than it was in 1918. "There is the incentive," he said, "which will cause history to repeat itself."

Mr. Schwinn's address was followed by a roundtable discussion of the 40-hr. week in maintenance work, in which the speakers consisted of C. M. Chumley, engineer maintenance of way, Illinois Central, Chicago; G. L. Sitton, assistant chief engineer, Southern System, Washington, D. C.; and A. A. Cross, engineer maintenance of way, New York, New Haven & Hartford, New Haven, Conn. Explaining that, with few exceptions, all maintenance forces on his road were working a straight five-day week, Monday through Friday, Mr. Chumley said that the short week had been in effect two week ends, one of them containing the Labor Day holiday, and that no difficulty had

---

TREASURER'S REPORT

SEPTEMBER 1, 1948 TO AUGUST 31, 1949

Cash Balance as of September 1, 1948		$1,491.59
RECEIPTS:		
Dues	$2,583.50	
Advertising	2,689.90	
Miscellaneous	2.00	5,275.40
Total Receipts		$6,766.99
DISBURSEMENTS:		
Salaries	$ 655.40	
Social Security and Withholding Taxes	100.81	
Stationery and Printing (Incl. 1947 and 1948 Proceedings)	3,710.07	
Postage	169.76	
Rent, telephone, and electricity	268.41	
Bond premiums	10.00	
Convention expenses (1948)	170.17	
Miscellaneous expense	141.84	5,226.46
Cash on hand August 31, 1949		$1,540.53
ACCOUNTS RECEIVABLE:		
Due from advertisers in 1948 Proceedings		1,758.00
Total as of August 31, 1949		3,298.53

L. C. WINKELHAUS,
Treasurer

been experienced. The objective on his road, he said, is to accomplish as much work in 40 hr. as was done in 48 hr., without increasing the number of men. This would be made possible through greater efficiency, he said.

A question raised by Mr. Sitton was whether, under present practices, the railroads would get 40 hr. of constructive work out of their maintenance forces, or something less than this figure. The roads must decide, he said, whether section foremen are to continue to patrol their sections, pointing out that little progress has been made in relieving them of this responsibility. By closer supervision and other measures, he added, the maintenance forces must be left free to devote all of their available working time to constructive work.

Mr. Cross said that the roads must depend on their supervisory officers in making the 40-hr. week work, and that for this reason such officers must be relieved as much as possible of all extraneous duties. The progress that has been made in mechanization has placed the roads today in a better position to solve the problems facing them than prevailed in 1918, in the opinion of Mr. Cross. A responsibility of maintenance men, he said, is to recognize the need for new and improved equipment and to cooperate with manufacturers in developing it. On the New Haven, said Mr. Cross, the maintenance forces are working a straight five-day week, except that at 14 locations, including large terminals the gangs may be worked on a staggered basis between November 1 and April 1, so that men will be on duty on Saturdays to handle emergencies. Similar arrangements can be negotiated at other locations, if necessary, he said.

SECRETARY'S REPORT

of

MEMBERSHIP FOR PERIOD ENDED SEPTEMBER 1, 1949

Active Membership — September 1, 1948		456	
New Members since September 1, 1948		57	
Reinstated		5	518
Reported deceased since September 1, 1948	6		
Resigned since September 1, 1948	5		
Dropped account non-payment of dues	30		
Transferred to Life Membership	9		50
Total Active Members — September 1, 1949			468
Associate Members — September 1, 1948		108	
New Associate Members since September 1, 1948		16	
Reinstated		2	126
Reported deceased since September 1, 1948	2		
Dropped account non-payment of dues	9		11
Total Associate Members — September 1, 1949			115
Life Members — September 1, 1948		85	
Elected to Life Membership since September 1, 1948		9	94
Reported deceased since September 1, 1948	4		4
Total Life Members — September 1, 1949			90
Honorary Members — September 1, 1948		3	
Elected to Honorary Membership		1	4
Reported deceased	1		1
Total Honorary Members — September 1, 1949			3
TOTAL MEMBERSHIP — SEPTEMBER 1, 1949			676

Disposal of Liquid Waste at Engine Terminals

Report of Committee

J. A. Jorlett (chairman), asst. engr., Penna., New York; R. W. Humphreys (vice-chairman), div. engr., No. Pac., Missoula, Mont.; R. C. Baker, supvr. b.&b., C.&E.I., Danville, Ill.; E. H. Barnhart, div. engr., B.&O., Garrett, Ind.; F. G. Campbell, ch. engr., E.J.&E., Joliet; H. B. Christianson, prin. asst. engr., C.M.St.P.&P., Chicago; R. D. Hellweg, asst. div. engr., G.M.&O., Bloomington, Ill.; H. E. Michael, assoc. ed., Ry. Eng. & Maint., Chicago; W. C. Oest, prin. asst. engr., Ft.W.&D.C., Ft. Worth, Tex.; F. C. Smith, gen. fire insp., A.T.&S.F., Chicago; C. E. Smith, vice-pres. (ret.), N.Y.N.H.&H., New Haven, Conn.; F. R. Spofford, assist. div. engr., B.&M., Dover, N.H.; L. C. Winkelhaus, arch. engr., C.&N.W., Chicago.

LIQUID WASTES resulting from railroad operations at engine terminals embrace numerous items, and it will be conceded that most of these wastes will find their way back to the natural state via ground water. The presence of these wastes in ground water is a matter which is giving concern to the legislative authorities of most of the 48 states. Back in the 1860-1870 decade many state health departments were organized, chiefly to combat the stream pollution resulting from the rapid construction of sewers, following their introduction at that time. The control was aimed at protecting people from water-borne diseases transmitted by sewage, and to control the discharge of toxic wastes which might menace public health.

From this start sprung strong regulatory bodies, and we now have such state organizations as department of health; fish and game commissions; department of public works; department of agriculture; department of commerce; department of conservation; and department of highways. Overspreading these are the national organizations, the counterparts of these state level groups.

The wide divergence of the word "pollutions" as interpreted by these groups is the cause of some difficulty to railroad managements. Some clarification of the problem may soon be realized since, in 1948, Public Law 845 was passed, whereby the United States Public Health Service was commissioned to establish a "Stream Pollution Laboratory" at Cincinnati, Ohio.

Liquid wastes from engine terminals include principally oil and oily wastes, sanitary wastes, and water treatment plant wastes. Just what is necessary for complete disposal of these wastes will depend on the location and type of material being handled, as well as the conditions at the point of discharge of the waste materials.

Money invested in equipment for the handling and treatment of wastes represents a capital expenditure, and the cost of operating and maintaining it becomes a part of the cost of hauling passengers and freight. The petroleum, chemical, and paper industries have found it necessary to set up separate administrative officials in charge of departments for pollution abatement. In the railroad field the solution of some part of the waste disposal problem usually involves operations which are part of everyday water treatment practice, such as flocculation, desedimentation, filtration, and sludge disposal.

Classification of Wastes

To meet properly existing or contemplated regulations, and to make efficient use of processes or equipment available to dispose of liquid wastes, classification of the waste material and analyses of the materials involved and their points of origin are essential. Wastes from railway operations can be classified generally in accordance with classifications set up for the petroleum industries. This scheme groups products in line with their principal objectionable characteristics. These classes may contain some materials that have the same characteristics, but generally they include the following:

(1)—Uncontaminated water waste.
(2)—Storm water waste.
(3)—Oil and oily waste, including emulsions.
(4)—Wastes which affect acidity and alkalinity.
(5)—Wastes which cause taste and odor.
(6)—Toxic wastes.
(7)—Wastes which are highly concentrated solutions of mineral matter.
(8)—Colored wastes.
(9)—Wastes which absorb dissolved oxygen.
(10)—Wastes which carry suspended matter.
(11)—Semi-solid or solid wastes.
(12)—Miscellaneous waste products.

Briefly, liquid wastes from engine terminals range from sanitary wastes, storm water, and water from blowdown and boiler wash and tender overflow from some of our older terminals where coal-fired steam engines are the primary power handled, to the wastes from oil-burning steam power and on through where Diesel fuel is used for the most modern motive power and light fuel oils are used in Diesels and electric engines for car heating boilers. Added to these wastes are the alkaline cleaning compounds or emulsified oils used for washing locomotives and locomotive parts; sludges from lime and soda-ash treating plants; and acids to regenerate in the demineralization water treating processes. It is readily seen that the twelve classifications in the foregoing paragraph generally encompass the wastes from most engine terminals.

Analyzing the Problem

From assembled records of all materials used and the amount wasted, namely, the quantity of each material which is discharged to a waste interceptor, selection of the type of treatment desired or required is determined. Degrees of treatment decided upon should be based on standards which have been established by the stream-pollution control agency having jurisdiction over the particular area in which the terminal is located. Consideration must be given to the reclamation possibilities of the waste material.

The next step is to go to the receiver of the liquid waste material. If the receiver is a stream or other body of water, a volume and waste analysis of it must be obtained. Stream flow records should be studied. Where discharge takes place to a local sewer system, conferences should be arranged with the officials in control of those facilities. They should be acquainted with the proposed plan of disposal and their approval of the proposed plan obtained before any construction is started. When the plan is reasonably assured of execution, much community goodwill can be gained by proper publicity releases on the effort of the company to assist in "Clean Water Programs."

Where treating plants are required, the operation and supervision should be assigned to individuals who are familiar with the method and purposes of the treatment. Frequent or constant tests of the disposal liquids and effluents must be made to be sure the plant is properly carrying out its functions.

Waste fuel oil from steam-powered locomotives on some of our large southern and western lines presents a real disposal problem. This waste accumulates at the roundhouse engine pits, the engine fueling cranes, the fuel oil storage unloading facilities, and at pits where either fuel oil tank cars or engine tenders are cleaned or repaired. This oil is collected because of its salvage value and to eliminate fire hazards, damage claims, and stream pollution. Sewer pipe lines of proper size connect the various points and empty into a properly designed reinforced concrete oil trap.

Most of the oily waste is in a mixture of hot water and condensed steam, so the next stage is to cool the solution sufficiently to cause the oil to separate from the water. This is accomplished in the concrete oil traps, which are built large enough and are separated into compartments by baffles. In some instances earthern pits augment the concrete traps to allow the solution to cool off. One company permits the oil to flow in small open channels to a point where it empties into a public stream, where proper traps are constructed. Not infrequently the effluent is not clear because the solution is too hot to allow sufficient separation.

The collection of the oil is readily possible because it is lighter than water and rises to the surface. In the traps the oil is skimmed from the surface in the last compartment and is pumped to a reservoir or a tank car, to be eventually returned to the locomotive. Installations of properly working traps have avoided complaints of State Fish and Game Commissions. On the other hand, in populated areas, where the traps have not been 100 per cent efficient, periodic complaints have been the rule, and some claims have been paid where overflow waste oil has gotten onto adjacent property.

With the increasing use of Diesel power, which requires a light grade fuel oil, leakage from underground pipes and valves will result in ground saturation and eventual pollution. Detection of this waste emphasizes the importance of the statement made earlier concerning studies of materials used and materials wasted. A large New England road which used light oil (kerosene formerly and now Diesel fuel oil) for generating steam to heat passenger trains, found that due to the accumulation of spillage in underground channels over a long period of years, oil appeared in the basement of a small hotel across from the engine terminal. Arrangements had to be made to collect this spillage.

Drainage from locomotive and car washing pits includes a combination of oil, and an oil emulsion or an alkaline washing compound. Some success has been accomplished where the alkaline compound is used by dilution of the drainage with large amounts of water. Otherwise, proper neutralization must be made.

A large western railroad has recently installed three commercially designed separators to handle (1) wastes from engine-house pits where boiler-wash wastes and other oil spillage and drippings accumulate; (2) waste from wash racks where engines are cleaned with an emulsified spray; and (3) waste from a tank where engine parts are soaked in a detergent. The largest separator for the first item involves a concrete structure which houses the tanks, separators, pumps, recovered oil tanks, and other apparatus required. The baffles in this installation were built of 5/16-in. steel plates. A feature of this layout is a bypass to take storm water which is collected by the same sewer system. The reclaimed oil from the separator at the wash rack installation is used for washing purposes again.

Another type of separator tank used by one railroad consists of three batteries of 36-in. glazed vitrified tile pipe set vertically, with tile pipe fittings to conduct liquids between the batteries. A concrete deck, with removable steel plate covers, permits access to the pits and protects the tile pipe from damage. Oil from the separator is removed manually.

At another terminal this company built two reservoirs by damming a small stream. The dams are about 80 ft. apart and have outlets at the bottom. When a sufficient amount of oil and grease collects on the surface it is ignited and burned in place.

Diesel Fuel Oil

Where Diesel engines are fueled, a large eastern railroad has recently installed track drain troughs. These troughs drain through a 3-in. pipe to a 550 gal. steel tank buried to suit drainage requirements. A tap is made in the tank for a pipe, to which is attached a 20-g.p.m. rotary hand pump for emptying the contents of the tank into drums. The filled drums are sent to a central reclamation point.

Another source of oil for disposal has risen from the use of Diesel power. Crankcase drainage must be handled. An eastern road reports that all oil from the crankcases of engines is drained into clean steel drums. The drums are marked with the engine number and a sample of the oil is sent to their laboratory for analysis. Oil found satisfactory is reclaimed for other engine purposes. Unfit oil is used as fuel oil at heating plants.

Bulletin 476, Nov. 1948, of the American Railway Engineering Association, has this to say of oil traps of standard American Petroleum Institute dimensions:

"Traps will handle liquids containing Diesel fuel oil, lubricating oil, and various oils used for lubrication. If trap is followed by hay or sand filters, and possibly a bio filter, emulsions can usually be successfully removed. This trap is 20 ft. wide and has 8 ft. of flow depth. The capacity of such a standard section in gallons per minute is not dependent upon the amount of oil present in the water; this controls the depth of the separation baffles; but it is dependent upon the gravity of the oil being handled. If the rate of flow is greater than a single standard section can handle, an additional section or sections must be added. For flow rates less than the capacity of a single standard section a smaller separator is more economical, but it must be designed of such dimensions that the same ratio between width and flow depth, as that of the single standard section, will be maintained.

"The standard A. P. I. trap, properly designed and operated, can reduce the oil content in water to as little as 5 parts per million, provided the oil is above 18 gravity A.P.I., and there is not much stable emulsion to be handled. The present tendency of regulatory bodies is to require a removal of oil to 10 parts per million, although many concentrations up to 60 parts per million have been permitted to exist. Where the gravity of much of the liquid waste results from a locomotive fuel oil below 10 gravity A.P.I., which is heavier than water, mixing of this oil with higher gravity oils gives a combination which can be handled by a gravity trap. Where emulsions are present, mixing of these wastes with acid wastes prior to entrance to the trap will assist in breaking up the emulsions. Sanitary sewage, excessive silt and sludge will hinder the operation of the trap."

Sanitary Sewage Disposal

At engine terminals in established centers, disposal of liquid sanitary sewage is handled by correctly designed sewers emptying into municipal sewer systems. At terminals away from such centers, and where the personnel is over several hundred persons, properly designed sewage collection and treatment systems must be designed. This will generally include a settling chamber where the solids are removed and are made non-toxic by a biological process; an aeration process to purify the liquid; and a dosage chamber where chlorine is administered to the effluent as a further precaution. This water can be made safe to discharge into streams of small flow, or into streams where it is again reclaimed for use as a water supply. Where discharge is made into a large stream or body of water, less treatment may be required.

Proper health agencies should be contacted where necessary to study satisfactory methods of disposal and the regulations applicable. For smaller terminals septic tanks, with suitable drainage fields, will adequately handle wastes. It is desirable in such an installation to separate wash waters and inorganic wastes and to keep the latter from flowing into the septic tanks so as not to effect the biological destruction of the solids by bacteria. The size and number of septic tanks should be as recommended by the manufacturer, and will depend on the number of people to be serviced.

Treating—Plant Wastes

Water treating plants at engine terminals include the chemical precipitation processes, such as lime-soda and the base-exchange processes called zeolite and demineralization. The disposal of wastes from these processes may present a local problem from the standpoint of stream pollution or their effect on the appearance of the surroundings. Some railroads use the soda-ash process where the precipitation of the minerals in the boiler water occurs in the boilers of the steam locomotives, and is blown out of the boilers at engine terminals or along the right-of-way.

One company reports that it collects the sludge from the lime-soda process in an earthen sump. When filled, this sludge is excavated with a dragline bucket, loaded into cars, and disposed of in wasting operations on the line. They had no success in interesting farmers in using it as a fertilizer, due to its lime contents, because of the cost of handling the material in its wet state. Where the effluent from the sump pits is conducted to city sewers, care must be taken to see that no solids pass along with the liquid, as removing sludge from such sewer lines may result in considerable expense. In like manner, discharging sludge into ditches and streams is readily detected and results in criticisms.

Where blow-down operations are done in engine terminals, sewer lines must be designed with proper size and fall or settling of the solids will occur and expensive cleaning of sewer lines will be necessary. Where the problem of sludge removal is acute, lime-soda plants have been designed with settling basins with mechanical equipment for sludge removal. These are built in small duplicate units, where the basins can be shut down alternately and the sludge removed by mixing it with large quantities of water. This diluted mixture can be discharged into streams having a fair flow of water, or into city sewers. When discharge is made into a stream, the outlet pipe should be located below surface where the greatest stream flow exists.

Where municipal sewage systems are carrying wastes of an acid nature from industrial plants, the lime-soda sludge will be very beneficial because of its neutralizing action. A railroad in one city receives credit for the amount of soda-plant sludge put into the city sewer because of this effect. Here again the problem of adequate flow in the sewer lines is important, and the handling of the sludge is transferred from the railroad to the sewage authorities. Several large industries, using this water softening process, have an output of sludge which exceeds five tons of solids per day. Because of high lime costs and other factors, they reclaim the water from the settling basins, dry the sludge, and calcine it back to lime.

With zeolite or demineralization plants, the disposal of brine solutions or acid solutions must be considered. Neither should have any deterring effect in local sewers if the dilution is high. If discharged into streams containing fish, dilution will be necessary to make the resulting content of the waste water and stream water safe to maintain the life of the fish.

Conclusions

From the foregoing, the complexity of the liquid waste disposal problem at engine terminals is evident.

This phase of railroad operations, and the increasing activity of regulatory bodies in insisting upon an abatement of stream pollution, will require extensive study and planning by a well-trained personnel.

DISCUSSION

President Barnhart began the discussion by reciting an instance where state authorities had lodged a complaint that a leaking oil line of the railroad was discharging oil into a sanitary sewer. The basis of the complaint was that the presence of the oil prevented the solids in the sewage from being processed. After the railroad had found and repaired the leak, the difficulties in treating the sewage solids were overcome.

J. L. Holmes (N. Y., N. H. & H.) cited another instance where, over a long period of time, oil had escaped from railroad facilities and saturated the ground over a wide area. Matters were further complicated, he said, when the government moved an adjacent shoreline 300 ft. farther out by filling, causing all pipe outlets to be blocked. When a nearby hotel complained to the railroad that the oil was getting into its basement, creating a hazard, the road was compelled to take steps to drain the oil from the ground. After consultation with engineers of an oil company, the road dug a ditch 3 ft. wide, 2 ft. deep and 200 ft. long. High tides then caused water and oil to enter the ditch, permitting the oil to be skimmed from the surface and pumped into tenders. In this way the oil was removed at the rate of 200 gal. a week, and, even at the end of a year of such operations, Mr. Holmes said, 50 gal. of oil a week is still being obtained.

Methods and Material for Fire Protection for Bridges and Trestles

Report of Committee

L. R. Morgan (chairman), fire prev. engr., N.Y.C. Sys., Detroit, Mich.; B. M. Whitehouse (vice-chairman), chf. fire insp., C &N.W., Chicago; G. W. Rear, Jr. (vice-chairman) asst. fire insp., So. Pac., San Francisco, Cal.; W. H. Begeman, b.&b. supvr., M.P., Jefferson City, Mo.; W. O. Bruce, spec. rep. opr. v.-p. C.R.I.&P., Chicago; M. D. Carothers, asst. ch. engr., G.M.&O., Bloomington, Ill.; H. M. Church, cons. engr., C.&O., Richmond, Va.; L. D. Garis, gen. br. insp., C.&N.W., Chicago; I. P. Gannon, div. engr., M.St.P.&S.S.M., Stevens' Point, Wis.; N. D. Howard, editor, Ry. Engr. & Maint., Chicago; H. A. Hunt, res. engr., T.&N.O., El Paso, Tex.; V. W. Hutchings, b.&b. supvr., So. Pac., San Francisco, Cal.; E. J. Littleton, Jennison Wright Corp., Granite City, Ill.; Lee Mayfield, res. engr., M.P., Houston, Tex.; W. J. Savage, asst. ch. engr., T.&P., Dallas, Tex.; H. von Schrenk, cons. timber engr., St. Louis, Mo.

FIRE PROTECTION, and particularly fire prevention, for bridges and trestles in remote or inaccessible locations has been a major maintenance problem for many years, and methods and materials used to overcome this problem have varied from the treatment of all timbers in structures to the replacement of open decks with ballast decks, or decks of concrete and steel.

On the majority of railroads it has been the policy to replace open-deck trestles with structures having ballasted decks as rapidly as renewals are necessary, this being particularly true with respect to main-line structures. However, since the replacement of all open-deck bridges and trestles with fire-resistant structures cannot possibly be accomplished for many years, the railroads will continue to have a large number of open-deck bridges and trestles to maintain, many in remote and sparsely populated locations.

Asphalt and Gravel Coating

After numerous tests and trials of various methods of protecting open-deck structures against fires, a western railroad developed a method of covering the exposed wood surfaces which gave promise of being extremely fire-resistant. This method involves the brushing or spraying on of a special patented asphalt compound, which, under test, was found to form a fire-preventive coating superior to anything previously used. Since its development, the decks of a large number of open-deck structures have been covered with this material, and the process of application has been greatly simplified and improved. At the present time a deck structure 30 ft. long can be completely coated within 2½ hr., if the materials are reasonably accessible.

The most effective results with this method are being obtained by making a hot application of a primer coat to the exposed wood surface, after the surface has been made reasonably clean of dust and dirt. The primer coat is applied with brush or spray to a reasonably heavy film, care being taken to see that all cracks or crevices are filled. Special care should be taken to be sure there is no exposed wood in corners and angles.

A second coating is applied immediately after the primer coat, by brush or spray, covering all surfaces with a 3/16-in. thick layer of the patented asphalt compound, which contains asbestos fibres and gilsonite. Immediately after the application of the second coat, crushed stone, washed, and from ⅛ in. to ⅜ in. in size, is spread over the hot compound in a layer about ½ in. thick. An excess of the aggregate should always be provided so that the compound will take up and anchor the maximum amount of the material.

As both the primer and top coating contain volatile solvents, the aggregate should be spread immediately behind the application of the second coat to minimize the possibility of fire, and so that the aggregate will anchor or set in the coating as the solvents volatilize. On important structures, or when weather conditions are such that volatilizing of the solvents is retarded, it may be well, for a period, to guard against possible fire by having sand available to smother any hot metal, ashes, or other combustibles which may fall on the surface.

Applying the Aggregate

No particular effort is made to apply the aggregate to the vertical surfaces of ties and stringers. However, a 1-in. board is nailed to the sides of guard timbers after the second coat is applied, leaving a ½-in. space between the board and timber, which is then filled with aggregate. In a few hours the board may be removed, leaving the aggregate held in place on the sides of the timber by the compound.

Spacer blocks and sidewalk ledgers are given an extra heavy coating of the compound and aggregate, particularly if in depressed position. However, recent construction changes bring spacer blocks to the surface of the ties, thus eliminating pockets for hot metal or ashes to fall into. As the compound has a tendency to stretch over cracks and to sink into low spots without affecting its continuity, the heavy application of the compound in depressed areas is desirable, compensating for the shrinkage and splitting of timber.

To obtain an effective and reliable fire-resistive coating it is necessary that the aggregate be thoroughly washed, and that the timber upon which the compound is applied be thoroughly dry. In warm climates it is not necessary to heat the primer or compound, but in cold weather it is beneficial to heat both, as well as the aggregate. The material bonds equally well on untreated or treated surfaces, with the exception of newly-creosoted timber. Best results in the case of creosoted timber are obtained after the timber has aged for one season after treatment.

The combination of compound and aggregate holds white hot brake shoe splinters or burning fuses away from the wood so they will chill or burn out without setting fire to the wood. Even when the heat is so intense that it will char the wood below the protecting coat, the wood will not burst into flames and burn.

The wide climatic variations on western railroads has been another factor of major importance in the application of fire-resistive coatings to bridge decks, since all previous treatments leeched out under rain and sun, or cracked and disintegrated under freezing weather. This compound has proved equally effective in desert and mountainous territories.

Experience of Second Road

Another railroad has reported the use of this method with satisfactory results, and excerpts from its report follow as a matter of additional information.

"The protection of the deck with a patented heavy roofing product and pea gravel appears to have excellent possibilities, with a life of eight to ten years, and can be applied at a reasonable cost. The product consists of a thin primer coat, followed by a final coat, ⅛-in. thick, into which clean gravel, ⅛-in. to ⅜-in. in size, is embedded. The tops of stringers, tops of ties, sides of ties over the stringers, and tops and sides of the guard rails, should be protected. The product can be applied by hand with mops or brushes, or by spray. The protection has been applied by hand to two trestles with a combined strength of about 1800 ft., at a cost of about $1 per lin. ft. of bridge. On another structure, 4,340 ft. long, the protection was applied by pump sprays at a cost of about $0.75 per lin. ft.

"An air-operated pump is placed in a drum of the primer and a second such pump is placed in a drum of the heavy final coating material. These pumps force the material through the supply lines to the spray head, where it is atomized by its contact with air. One pump can be used for both coats, but this will require the cleaning of the supply line after each coat is applied. The pumps operate on 30 to 40 lb. air pressure. A 100-lb. compressor with a long air supply line will reduce the moving of the compressor to the minimum, yet furnish sufficient pressure to operate the pumps.

"All surfaces to be protected should be free from dust, dirt and surface moisture. If the timber is wet, proper adhesion cannot be obtained and 'peeling' of the material will result. The thin primer coat should be followed by the final coat within 20 to 30 min., and the ⅛-in. final coat should be followed by the embedment of pea gravel within 40 min. The gravel should be tamped or rammed into the material to get adequate embedment. To embed the gravel into the coated sides of guard rails or ties, a short, thin board is first placed against the bottom of the guard rail or tie to form a trough. When this trough is partly filled with pea gravel, and the board raised with a slight pressure against it, the gravel is embedded on the sides of the timbers. A foreman and five men are required to apply the treatment if the compressor can be kept off the bridge, but two additional men are required for flagging if the compressor is kept on a push car. The work should be carefully inspected before the gang leaves the site, and any irregularities in the coating corrected. If 'bleeding', caused by an excessive final coat, is detected, additional gravel should be applied.

"Lighted fusees and white hot pieces of metal have been laid on boards given this type of protection and have burned out without damage to the protection or the boards. The primer and final coat will fill and seal all cracks in the timber under them, thus preventing the entrance of water and prolonging the life of the timber."

The protection of wood in railway bridges and buildings was discussed in an excellent paper by George H. Hunt, Director of the Forest Products Laboratory of the Forest Service Bureau, U. S. Department of Agriculture, presented before this association last year and printed in the proceedings of the 53rd annual convention. This paper did not confine itself to fire protection, but contains several pertinent paragraphs which we commend to your attention.

There are several methods of retarding the spread of fire on bridges and trestles which have been in use for a comparatively long period of time. Such methods include the asbestos-board shielding of bents, the use of fire-resistive construction at intervals in long trestles, and the use of metal coverings for protection against the ignition and spread of fire. Since much information concerning these methods is already available, they will not be discussed in this report.

Another important phase of this subject concerns the protection of bents against fire. It is, of course, very important that the ground around and beneath timber trestles be kept free of vegetation and other combustible material at all times, for a distance of at least 15 ft. from the nearest timber. The number of cleanings per year will depend upon climatic conditions, but cleaning should be done at least four times annually in some southern localities where rainfall is heavy and the growing seasons are long. The cleaning is usually done by "shovel cutting" and, occasionally, where the ground will permit, by power machines, such as graders or bulldozers. Unfortunately, many of the timber trestles must be shovel cut. This costs about $0.32 per lin. ft. of trestle (50 ft. wide) for each cleaning, which represents a very heavy yearly expense when three or more cleanings are required annually and many trestles are involved.

Last year one railroad applied a granular, unrefined borax under and around five timber trestles as an experiment, and the results were so gratifying that this year five miles of trestles were treated. The estimated annual saving, based on one application, is at least $0.77 per lin. ft. The chemical is not injurious to man, animals or fish, and is non-corrosive to ferrous metal. One application of 12 lb. per 100 sq. ft., applied by hand, will give protection for at least a year, and in many cases for two years.

All persons making inspections of bridges should be on the alert for and remove any combustible substances that might be, or might become, in contact with any timber or piling. Dry leaves, paper and rags are often found on decks and make excellent places to start a fire when exposed to burning oil, cinders or hot metal falling from passing trains. Any partly decayed timber that forms a fire hazard should be removed.

Suppressing Fires

It is in order to consider means of suppressing or extinguishing such fires as may occur at bridges and trestles. One of the most common means is, of course, the familiar water barrel and pails, and often this is the only feasible method because of the isolated location of the bridge or trestle, which makes the cost of other protection prohibitive. The necessity of adequate inspection of such barrels and pails cannot be overemphasized because of the possibility of damage or theft, which would completely defeat the purpose of the protection.

Another peril in many sections of the country is that of freezing, which is customarily overcome by the use of a calcium chloride solution in the barrels, rather than plain water. This solution should be prepared in a separate container and then strained and put in the fire barrels. The amount of calcium chloride required per gallon of water must be such that no freezing will occur at the lowest possible temperature encountered in territory in which the barrels are located. Usually four pounds of the chemical to each gallon of water will be sufficient for most parts of the United States.

The use of hose and under-deck sprinkling systems is possible, but such must be confined largely to sections of the country not subject to low temperatures because of the large cost that would be involved in protecting such equipment against freezing. Where such installations are contemplated, it is necessary that one be guided by the particular circumstances encountered, because conditions are so variable that no set rules can be promulgated which will be uniformly applicable.

DISCUSSION

T. E. Jackson (S.P.), discussing the asphalt-and-gravel method of fire protection, referred to the difficulty of getting stone screenings to adhere to the sides of ties and guardrails and stated that he preferred placing them with the hands instead of with shovels. S. White (S.P.) said that he had found it too costly to try to apply screenings to the sides of timbers and had given up this practice. Lee Mayfield (M.P.) said that he uses a board along the sides of the timbers to form a trough, which facilitates the application of screenings. Mr. White was not convinced, however, and said he had found that in hot weather the screenings loosened and dropped off.

George Walker (M.P.) stated that he had been applying a coating of sand to newly-creosoted timbers and that it had proved effective for fire protection. L. R. Morgan (N.Y.C.) said that he used cement in the same manner for this purpose, a practice to which H. W. Routenberg (B.&O.) also ascribed, declaring that it held up well under foot traffic.

G. J. Bass (G.C.&S.F.) observed that, when vegetation is cut under a bridge, it should be removed from the premises. Otherwise it would present a worse fire hazard than when green, he said.

R. E. Dove (R.E.&M. Cyclo.) stated that the use of water barrels as fire protection on bridges was being abandoned by some roads because they never seemed to contain water when an emergency arose. P. F. Huston (C.&S.) agreed that many barrels were used as targets by hunters, rendering them useless as water containers. He said that on his road these barrels were filled with sand, especially in territory where water is hard to obtain, and that the sand is effective in quenching fires.

Pier Construction and Maintenance of Waterfront Terminals

Report of Committee

F. W. Hutcheson (chairman), supvr. b.&b., C.&O., Newport News, Va.; J. J. Winn (vice-chairman), supvr. b.&b., B.&M., Boston, Mass.; A. E. Bechtelheimer, engr. br. (ret.), C.&N.W., Winnetka, Ill.; J. R. Burkey, cons. engr., Columbus, Ohio; R. R. Clegg, dist. sales mgr., Am. Lbr. & Treat. Co., Chicago; Geo. E. Detzel, Geo. E. Detzel Co., Cincinnati, Ohio; F. M. Misch, gen. b.&b. supvr., So. Pac., San Francisco, Cal.; G. H. Perry, mast. carp., Penna., New Castle, Pa.; Geo. H. Paris, R.R. Rep., Portland Cement Assn., Chicago; H. W. Routenberg, mast. carp., B.&O., Baltimore, Md.; F. J. Stewart, ch. engr., Broward County, Port Auth., Port Everglades, Fla.; J. S. Hancock, br. engr., D.T.&I., Dearborn, Mich.

THE IMPORTANCE of adequate and properly maintained waterfront facilities was clearly brought to our attention during the days of World War II. These facilities are of equal importance in times of peace. Much of the operating revenues of our various railroad systems is derived from the handling of both export and import commodities to and from our waterfront terminals. Proper design and good maintenance of such terminals tend to lower handling costs, while obsolete design and improper maintenance result in higher wharfage costs. This is equally true with respect to inland waterway terminals.

In many instances the piers and appurtenances of various waterfront terminals are either municipally or privately owned, being leased to the particular railroad which serves them. A number of such terminals are owned and maintained by railroad companies. Generally, leased facilities are maintained by the railroads.

Design and Construction

Until recent years, the general type of pier construction consisted of a timber pile substructure, with a timber shed. In some cases, however, steel superstructures were used on timber substructures. During the past few decades there has been a very definite trend toward the use of pre-cast concrete piling for the supporting members, with various combinations of timber and steel for the remainder of the structure. In some cases concrete has been used for the entire structure. Another type of construction involves the use of creosoted timber piles capped at about mean low water and concrete or timber plank installed thereon. This may be used to support an earth fill for land track installation, or the superstructure of a pier shed as well as tracks.

Use has been made of tubular steel piles, filled with concrete, in the construction of at least one pier on the West coast (Long Beach, Cal.), and also one on the East coast (Hampton Roads, Va.), the latter being owned and operated by the U. S. Navy. These installations are considered an innovation in pier construction, as they represent the first times that tubular steel piles have been used to any great extent in salt water.

One of the outstanding advantages in the use of this type of pile is the ease with which the length can be altered in the field. Low clearance problems can be overcome by driving the piles in short sections and welding the joints in such a manner as to make the splice equally as strong as the remainder of the pile.

In designing and constructing any pier structure at which ships and barges are to be docked, provision should be made for an adequate fender system. This is especially true in the case of concrete structures. If the concrete structure is of sufficient width to absorb the stresses resulting from docking operations, timber and piles may be attached directly to the concrete pier by means of tee bolts secured to cast iron inserts which have been previously imbedded in the concrete. When this type is not feasible, it becomes necessary to install a complete timber system which will be entirely independent of the concrete portion of the structure. The width of these independent systems is limited to a minimum of approximately six feet, as it is impossible to make them stable with a lesser width.

Another development of recent years in connection with fender systems is the use of radial or rounded corners on the outshore ends of piers to replace the conventional square corners with pile clusters or dolphins for protection. The radial corner receives its strength from a series of diagonal walers and vertical piles, with the walers located at low water elevation and also just below the floor system of the pier apron. By means of ranger timbers this construction is made an integral part of the apron structure. It is usually protected on the outside by fender piles driven closely together, and at the point of curvature lining up with the end and side fender systems. Thus there is no protruding obstruction in the entire line of the fender system and ships may be docked with less possibility of damage to hull plates, and also with greater ease on the part of the tugs.

Careful consideration should be given to plans and specifications for new structures, as future maintenance will be governed in large measure by these factors. Local conditions and requirements vary to a great extent, and each project must take these into consideration. The present high construction costs make it imperative that all materials be selected carefully, giving due consideration to durability and permanence.

Several investigations have been made as to the durability of concrete in seawater. The general conclusions of these investigations are that the three most important requisites for concrete subject to such water are: (1) A well-designed mix capable of producing an impervious concrete, (2) careful construction methods to prevent segregation and honeycombing, and (3) proper curing methods. If these requisites are complied with, durable concrete can be produced for exposure to seawater. Air-entrained concrete improves its durability in seawater when subjected to freezing and thawing. Successful use has been made of high-early-strength cement in precasting concrete piles for use in seawater.

Timber piles are still widely used for the substructures of waterfront facilities. It is recommended that a thorough creosote treatment be given all piles used in such service, especially those to be used in areas infested with marine borers. American Wood-Preservers' Association specifications for marine piling are available. The protection of wood piles against marine borers is a problem, and much investigation work to minimize this problem is being carried on. Protection of the pile cut-off is of extreme importance. Other sub-structure timbers, such as bracing, caps and deck stringers, should be treated with creosote and preframed and bored before treatment.

In designing superstructures, recent development in timber treatment with fire-retardant salts give the designer a construction material with qualities which very definitely reduce fire hazards. These salts are subject to some leaching when exposed to the weather, but are satisfactory for interior installations. Some of these fire retardant salts afford protection against decay.

Use is being made by some railroads of greenheart piling and sawn timber originating in South America, for both construction and maintenance purposes. This wood requires no treatment against decay or marine borers and hence can be framed on the job without penalizing its service life. The cost of this timber, however, is greater than that of native woods.

Several installations of greenheart piles have been made during the past few years, chiefly for pier fender systems and ferry slips. One railroad has recently constructed a new concrete coal pier with independent fender system constructed entirely of greenheart piles and timber.

Maintenance

The replacement of timber-pile substructures is probably the most costly item of pier maintenance. An out-of-face renewal occurs only every 25 to 35 years. In the case of open-deck piers or other structures not involving sheds, the problem is a comparatively easy one. There are three possible methods to be used where sheds are involved. One is to remove the shed to permit the use of pile-driving equipment. The second provides for cutting holes in the roof and driving the piles with floating equipment. There are certain limitations to this method in that the width of the pier cannot be more than twice the working distance of the pile driver boom. This method is particularly adaptable to spot renewals. The third method involves the driving of splice piles with a rig that operates beneath the roof structure and which eliminates disturbing the roof. This method is not too strongly recommended, but, if used, care should be exercised to make sure the splices are well below the mud line.

Underwater inspections should be made periodically of structures with timber pile foundations. The frequency of these inspections will be governed by the rate of infestation of marine borers. The use of test boards indicates the rate of this infestation.

It has not yet been possible to develop perfect casting and driving methods for precast concrete piles, with the result that it often becomes necessary after a varying period of time to restore a portion or all of the piles in a particular structure. The movement of ice in the northern areas, as well as harbor water pollution in many locations, are also factors that have a definite bearing on the durability of concrete piles.

A large eastern railroad is now in the process of restoring approximately one thousand 15-in. disintegrated square piles. The work is being accomplished by the use of floating steel caissons 4 ft. square, 5 ft. 6 in. deep, and divided in half vertically. These halves are attached to individual piles in pairs with the bottom approximately three feet below mean low water, by means of a closing device which clamps tightly against the pile. All joints are sealed with strips of sponge rubber.

The caissons are then dewatered and the piles are ready for cleaning and the removal of all disintegrated concrete. If any of the original reinforcing steel has deteriorated it is replaced and additional bars are installed for the new concrete section. A complete wrap of wire mesh is also used on each pile. The new concrete is applied in a 16-gauge wrought-iron form, which is 22 in. square, and made up in three sections, which provides a depth of approximately five feet.

The maintenance of decking and runways is an item of considerable importance in the operation of waterfront facilities. The majority of our present-day piers have wood decks. To protect the timber from wear, various types of overlay have been used.

In some locations bituminous concrete has been used as a wearing surface for pier floors. After respiking the underfloor, a first layer of coarse binder is laid two inches thick and compacted with a five-ton roller. A second layer of approximately one inch thickness, with fine aggregate, is then applied as a wearing surface. One such installation has given good results over a period of five years with very little maintenance, and should be serviceable for many years to come. This type floor surface is sufficiently flexible to take care of structure movements, and indentations from various causes will heal quickly with traffic movements. A new concrete merchandise pier recently erected in the port of Hampton Roads, Va., has a one-inch wearing surface of bituminous material laid over the concrete deck.

Good results have been obtained from the use of one-inch asphalt planking applied over heavy timber decks. The average life of the asphalt planking is from 12 to 15 years. The sub-floor in this type of installation will last almost indefinitely, provided it is protected from moisture. This means that it should be confined to inside use, unless the sub-floor material has been treated.

Steel plate is sometimes used as a runway. It has been found that a ⅜-in. thickness is the minimum that should be used for best results. Both sides should be beveled to permit the easy mounting of trailer and tractor wheels during trucking operations.

Native hardwoods for decking have given very good results. Treated black gum provides a good wearing surface. Some inside installations have been in existence for 13 years. Soft woods are not recommended for decking purposes unless protected by an overlay of some type.

Sawed greenheart planking, and Mora, another South American hardwood, have also been used for decks. Both must be well secured to the deck stringers to prevent warping and buckling. An outside installation of greenheart has been in existence for 14 years and subjected to heavy trucking, with very little sign of wear and no sign of decay. The greater strength of these materials permits the use of planking from one to two inches thinner than would be required for oak, pine or similar woods.

Pier roofs are usually of the built-up type, either four or five ply, with gravel or slag surface. All roofs should be maintained in good condition in order to prevent damage to export and import merchandise.

Limited use for maintenance has been made of timber treated with fire-retardant salts, and its use would not seem practical unless an out-of-face renewal is being made. However, any measures that will tend to reduce fire hazards on waterfront properties should be considered.

Every maintenance supervisor on waterfront terminals is confronted with the problem of damage to properties by ships and other floating equipment. Such damage is more or less continuous and of varying severity. Therefore a small stock of piling and heavy timbers should be stored nearby for making any necessary repairs.

Conclusions

Waterfront terminals are costly installations from the standpoint of both construction and maintenance, and new projects should be designed with this in view.

In designing new waterfront facilities valuable engineering assistance can be secured from the U. S. Navy, as it has had wide experience in this type of construction.

Careful thought should be given to each project that involves heavy replacements to determine whether out-of-face renewal is desirable instead.

DISCUSSION

H. A. Matthews (St. L.-S. F.) raised a question regarding the difference in cost of greenheart piling and concrete piling. Chairman Hutcheson stated that the cost of concrete piling varied in accordance with the design of each railroad, but that greenheart piling costs about two dollars a lineal foot.

Answering a question put by Mr. Matthews regarding the kind of waterproofing to use as protection for concrete piles in sea water, Lee Mayfield (M. P.) expressed the opinion that the only kind of pile that should be used in salt water is the marine-treated creosoted wood pile. Those driven on his road have been in service only a few years but they seem free from the attach of marine borers, he said.

J. M. Salmon, Jr., (L. & N.) said his road has a pier on a concrete foundation that has been in service for 25 years. The piles are from 50 to 90 ft. long, coated with creosote and are still in good condition, with only a few checks in the surface of the creosote over the reinforcing. He added that his road depends solely on a driver's inspection for determining the necessity for making pile renewals. W. H. Pryor (St. L.-S. F.) then asked if the L. & N. used concrete jackets for repairing concrete piles, saying that he had found that the borers worked under the jackets, causing them to fall off. Mr. Salmon agreed that concrete jackets were not practicable and said they were not being used on his road for repairs. C. M. Setzer (Sou.) said concrete piles with Gunite had proved satisfactory on his road, and that they did not shatter when driven with a 7,000-lb. Vulcan hammer.

One of the committee members stated that greenheart piles should be banded before driving to prevent them from splitting. He added that greenheart piles are so hard that a heavy blow might knock a chunk of the wood loose. For this reason, he said, such piles should be used only as inner piles and not on the outsides of pile fender clusters. Also, he said, greenheart timber plank should be fastened with screw spikes, because this species of timber has a tendency to curl.

Methods of Prevention and Removal of Corrosion from Steel Structures

Report of Committee

W. C. Harman (chairman), b.&b. supvr., So. Pac., San Francisco, Cal.; M. Block (vice-chairman), engr. br., I.C., Chicago; W. K. Manning (vice-chairman), supvr. br., Erie, Port Jervis, N.Y.; J. T. Andrews, asst. engr., B.&O., Baltimore, Md.; Lem Adams, vice-pres., Oxweld R.R. Ser., Chicago; G. W. Benson, supvr. br.; C. of Ga., Macon, Ga.; A. B. Chaney, asst. engr. m.w., M.P., St. Louis, Mo.; C. J. Diver, vice-pres., Morrison Ry. Sup. Corp., Buffalo, N.Y.; F. W. Evinger, R.R. sales, Patterson Sargent Co., Chicago; H. M. Harlow, asst. gen. supvr., b.&b., C.&O., Richmond, Va.; R. W. Johnson, asst. engr., C.M.&St.P.&P., Chicago; P. L. Koehler, supt., C.&O., Peach Creek, W. Va.; C. C. Rausch, asst. vice-pres., Dearborn Chem. Co., Chicago; J. R. Showalter, br. engr., M.P., St. Louis, Mo.; R. A. Westergren, mast. carp., Penna., Sunbury, Pa.; H. L. Veith, b.&b. supvr., Sou., Birmingham, Ala.; C. M. Colvin, const. supt., Armco Dr. & Met. Prod., Inc., Berkeley, Cal.

MANY methods of rust prevention have been tried, some in an experimental way, but there is still a large field for investigation. There are three principal methods by which the corrosion of steel structures can be combatted:

(1) Choice of more corrosion-resistant steels, such as alloy steels, high-tensile steels, or non-ferrous materials.

(2) Use of protective coatings; (a) Metallic coatings, such as galvanizing and zinc, lead, tin or other metal platings. (b) Non-metallic coatings.

(3) By cathodic the method or similar devices.

Special Steels

Copper-bearing steel increases the corrosion resistance of the steel at only a slight additional cost. Such steel has been used to some extent, but has not yet come into such general use as to warrant its general adoption.

The use of high-tensile steels of silicon or nickel and other alloy elements is increasing, and while not generally used in all types of railway bridge construction, sufficient tonnage is in service to prove the value of its corrosion-resistant qualities.

In the San Francisco area, where 44 million pounds of steel were used in the Suisun Bay railway bridge, approximately 80 per cent was silicon steel. While the maintenance of this bridge is of the best, inspection shows that the silicon steel members have much better resistance to corrosion than the carbon steel members, particularly the eye-bars. Farther up the coast, highway engineers, in designing bridges, have resorted to nickel alloy, high-strength steel. Recent reports indicate long life and low maintenance costs. The value of these metals should not be underestimated, and much wider use of them can be anticipated, resulting in large savings in maintenance.

Metallic Coatings

Galvanizing is the most widely used metallic coating for preventing corrosion. Galvanized steel or iron sheets are used extensively in railway structures. Galvanized bolts, and pipe anchors for pole lines, are other important uses. In the bracing of the bents in the trestle across Great Salt Lake in Utah, and in seawall construction on the Pacific coast, galvanized steel bolts were used. These have been in service in the trestle since 1923, and some removed recently during repair work were found in excellent condition and were reused. Bolts used in the seawall for anchoring the laminated wooden facing to the concrete are still in good condition after eight years of wet and dry salt water conditions.

Metallized coatings applied to steel structures, by spray-gun process, have been used where other means of preventing corrosion have failed. Generally this method is utilized where aggravated conditions warrant the expenditure, such as at locations where brine drippings from refrigerator cars cause heavy damage to steel bridge members.

A bridge at Kansas City, adjacent to a packing shed, was given such protection. This bridge, which was subject to excessive drippings, had been previously protected by ⅜-in. iron plates. The first application to the floor system was made about 13 years ago. This consisted of a spray coating of zinc, 0.008 in. in thickness. The cleaning in this case was not very thorough, so more attention is now being given to cleaning operations, and a coating of 0.012 in. thick is being applied.

It is anticipated that this metallic coating will protect these members for 20 years. Based upon this experience, the road owning this bridge has adopted the metallizing of the top flanges of floor-beams and stringers before they are erected in a structure. The cost of these applications varies, ranging from $1.00 to $1.25 per sq. ft. in the field. When done in the shop the cost can be reduced to 60 cents to 75 cents per sq. foot. The process of metallic coating spreads a tight film of corrosive-resistant metal over every joint in laps, seams and around rivet heads where moisture might pocket, and thus reduces corrosion.

Removal of Corrosion

The cost of removing corrosion from steel structures includes: (1) The preparation of the surface; and (2) the application of the protective coating.

The preparation of the surface often absorbs 25 to 80 per cent of the entire labor cost of the job. The higher costs are sometimes due to deferred maintenance, but are usually attributed to atmospheric conditions or chemical action. Since the major cost of the removal of corrosion involves the cleaning of the surface before paint is applied, more effective and economic methods of cleaning and removal of corrosion are being developed. The most widely used method for removing rust is the steel scraper, the wire brush and chipping hammers. Air tools require compressors and contingent equipment, and are generally used where more extensive or heavy cleaning is to be done. Flame cleaning, using a broad oxyacetylene flame, has more recently been employed. This method greatly accelerates the removal of all foreign matter, including rust, if used in conjunction with the steel wire brush.

It is more difficult to use in the field, on some roads, due to traffic restrictions, but can be used in the fabricating shop to great advantage, particularly in the removal of mill scale. The shop paint coat should be applied while the surface is still warm.

Another method of cleaning is sand blasting. To be done economically, this method requires complete equipment of proper capacity. Its use is confined largely to the cleaning of large areas. It is efficient and removes all foreign matter and the mill scale, leaving the surface ready to receive paint. Dry sand for sand blasting should be hard and sharp, and the nozzle should be of a size for the type of sand to be used.

The use of sand blasting is restricted to more isolated areas, where the harmful effects of flying particles is minimized. Moisture may be carried to the steel unless the sand is thoroughly dry and atmospheric conditions are satisfactory. This may be a factor in determining the method of cleaning. Employees may also raise objection to the dust inherent in this method. Steel shot has been used where facilities are provided for its re-use, but generally its use is only feasible in plants.

The cost of cleaning steel structures varies so widely that it is difficult to give any unit costs.

Protection by Painting

Drying paints with red-lead primers are still used extensively, primarily because of the greater penetration of linseed oil. New steel should have a shop or prime coat, one intermediate coat, and a final finish coat. Structures previously painted should have two coats—a spot or prime coat and a final coat. For minimum maintenance, one finish coat is desirable. This applies where the existing surface is in good condition, or for appearance. Proper cleaning prior to painting is most important. The steel surface should be free of moisture and improper temperatures during painting should be avoided.

Two methods of painting are in general use. Some favor brushing, claiming that the brush pressure will help to make contact with the steel, giving better adhesion. Spray painting can be very satisfactory when applied over clean surfaces which are thoroughly dry. The selection of the proper paint is very important. A wide variety of synthetic resins, some of which possess special properties, have been placed upon the market, making it highly desirable to study conditions before a paint is selected. However, most roads make use of a basic paint containing red or blue lead and linseed oil as a primer, and follow it by a good long oil finish coat.

Softening Agents

Softening agents as rust-preventive compounds, generally classed as petrolatum, have been used to some extent for the past two decades. One road has used such rust preventives on steel viaducts along the sea coast and claims excellent results. Previous to their use, steel structures, painted with the red lead and carbon or graphite paints, required frequent spot coating and heavy cleaning. By using rust-preventive compounds an out-of-face job is required only every five or six years, instead of two years, resulting in a saving in maintenance costs of as much as 50 per cent. These softening agents can be diluted and sprayed, but some roads prefer brush application, which assures a more uniformly heavy coating, especially on rivet heads. A coating not less than 1/16 in. in thickness on webs and other wide areas seems desirable, but on lower girder flanges, laterals, lacing bars, and rivet heads, a heavier coating is applied, giving better protection.

Cathodic Protection

Cathodic protection has been utilized to some extent on railway installations and in protecting pipe lines and boilers from corrosion, and many installations have been made in water tanks. Its application to steel bridges, buildings or turntables is probably more in the future. One railway has ten cathodic installations in water tanks of various sizes. Inspection of the oldest installation—in service three years—indicates an arresting of corrosion, except a heavy deposit of flake rust at the base of the walls.

The nature of the soil or water, the amount of moisture, the presence of foreign objects or stray currents, all influence the type and extent of cathodic protection to be used, so each installation must be carefully studied. While such protection is basically the same for protecting all steel structures, the feasibility of such protection is being studied extensively by national engineering groups. In the San Francisco Bay area, an active committee, including representatives of interested industries and the railways, is making field test installations to arrest the corrosive action on buried pipe lines and conduits. This corrosion has increased at an alarming rate since the removal of electric car lines in this area—the car lines having furnished the electric field which had previously held corrosion in check.

Conclusion

Methods of preventing and removing corrosion from steel structures are varied and their effectiveness depends greatly upon the character of the structure, local conditions, and the character of the structure, local conditions, and the character of corrosion. The choice of more corrosive-resistant materials will decrease the necessity for frequent cleaning of structures.

The use of protective coatings on parts of steel structures, either metallic or non-metallic, will minimize the extent of corrosion. In the protection of steel surfaces by means of paints, clean dry surfaces are essential before the paint is applied. Cathodic protection on some types of steel structures, such as water tanks, is being used with some success.

DISCUSSION

In the absence of Chairman Harman the report was read by G. W. Benson (C. of Ga.). H. W. Routenberg (B.& O.) began the discussion by recounting the effects of mill scale on paint coats. He said that if the shop coat is applied before the scale is removed the mill scale pops off in about six months, leaving the bare metal exposed. F. W. Evinger (Patterson Sargent Co.) advised that the adverse effects of mill scale on the paint will sometimes continue over a period as long as 20 years, but that they could be eliminated by proper cleaning before painting. Some roads, he said, specify that their steel be delivered without a shop coat, and that, after the steel has weathered for some time, they remove mill scale and oxidation by sand blasting or by the use of an oxyacetylene torch before painting. This practice, he added, produces an excellent surface for painting.

R. A. Van Ness (A.T.&S.F.) brought up the matter of spot painting, saying that he did not believe in painting the inside surfaces of members just because the outside surfaces were being painted. It has been his experience that the surfaces exposed to the sun require painting most frequently. He added that many of his bridges were in a dry, warm territory, but that generally he obtains about 12 years of service from one prime coat and one cover coat. In answer to a question raised by T. E. Jackson (S.P.) as to whether or not he uses a protective coating during the period that steel is weathering, Mr. Van Ness said that a rust-preventative compound is used which is wire-brushed off the steel before the oil paint is applied.

Lee Mayfield (M. P.) stated that he applies a rust-preventive compound by spraying, pumping it direct from the drums without dilution. This produces a coating about 1/32 in. thick, he said, which hardens quickly in the heat.

Mr. Benson said that flame cleaning was most desirable for cleaning the insides of water tanks, especially those that cannot be removed from service for any great length of time, because the warmed steel facilitates the subsequent drying of the paint.

In reply to a question raised by L. C. Winkelhaus (C. & N. W.) regarding the durability of aluminum paint, Mr. Evinger said that the use of the proper vehicle was most important in obtaining satisfactory performance. President Barnhart stated he had used aluminum paint on both new and old work, and that, to date, its performance had been satisfactory.

J. L. Dougherty (W. Md.) asked about the effectiveness of flame cleaning with respect to removing mill scale. C. A. Daley (Air Red. Sales) advised that mill scale will pop off readily with the use of a torch, adding that the surface should then be painted while the metal is still warm.

Installation and Maintenance of Built-Up Composition Roofing

Report of Committee

W. H. Bunge (chairman), asst. engr., M.P., Houston, Tex.; L. E. Peyser (vice-chairman), arch. engr., So. Pac., San Francisco, Cal.; V. E. Engman, ch. carp., C.M.St.P.&P., Savanna, Ill.; W. A. Huckstep, gen. bldg. supvr., M.P., St. Louis, Mo.; A. C. Johnson, eng. design, E.J.&E., Joliet, Ill.; E. B. Jones, supvr. b.&b., C.&O., Clifton Forge, Va.; L. P. Kimball, engr. bldgs., B.&O., Baltimore, Md.; C. LeDuc, fld. sales mgr., Acorn Refining Co., Chicago; W. F. Martens, gen. fore. b.&b., A.T.&S.F., San Bernardino, Cal.; R. H. Morrison, prin. asst. engr., Bang. & Aroos., Houlton, Me.; C. R. Pritchard, asst. arch., Sou., Charlotte, N.C.; J. W. Shoop, vice-pres., Lehon Co., Chicago; C. U. Smith, const. engr., Lindsay, Cal.; L. L. Smith, asst. b.&b. supvr., So. Pac., Dunsmuir, Cal.; P. V. Thelander, asst. engr. maint., C.&N.W., Chicago; E. Park, drfts., M.P. Lines, Houston, Tex.

THE ROOF is a very essential part of any building as it materially affects the life, as well as the usability, of the structure. The use of good materials is important, but more important is good workmanship, without which a first-class roofing job cannot be obtained. Built-up roofing is used more extensively on flat or nearly flat roof surfaces, but in some instances is applied to roofs with a slope as great as six inches to the foot.

There are many types of built-up roofings, and in selecting the type of roofing for a particular structure it is necessary to consider the pitch of the roof, the type of surface to be covered, the use for which the building is intended, the fire resistance of the surface required by laws and ordinances, or desirable for other reasons, including appearance and the anticipated life expectancy of the structure. When manufacturers' specifications are complied with, built-up roofs may be guaranteed or bonded for periods of 10, 15 or 20 years, although the time limits specified do not necessarily indicate the life expectancy, as additional life may be obtained by proper installations and careful maintenance.

Bonding Mediums

The two bonding mediums most generally used are coal-tar pitch and asphalt, pitch being used with tar-saturated rag felts and tar-saturated asbestos felts. Pitch may in some cases be preferable on flat or nearly flat roofs with a slope of 2 in. to the foot or less, and when finished with a slag or gravel surface. However, on one railroad system smooth surface asbestos roofing is used almost exclusively. Some manufacturers' specifications provide for the use of pitch on a slope of 6 in. to the foot by finishing the surface with asphalt and slag or gravel. Flat coal-tar pitch roofs are in some cases inundated with a few inches of water to stabilize temperature.

Roofing asphalts are obtained from two sources — petroleum by-products from the refining of petroleum oils, and native asphalts mined from the earth. Petroleum asphalts, when properly blended, produce a good bonding and weather-resistant material. Native asphalts contain much foreign materials and require considerable refining prior to use as a roofing material. Bonded asphalts are preferable as they are properly blended and contain less impurities.

Inspection of Surface

After the type of roofing desired has been selected and proper materials provided, an inspection of the surface to be covered should be made in order to see that it is in proper condition for the roofing application. Steel roof decks should be covered with an insulating material, preferably one or two laminations of a ½-in. insulating material.

Concrete or gypsum roof slabs must be coated with a manufacturer's primer prior to application of the built-up roofing.

Wood sheathing should be closely inspected for defective nailing, voids in board joints, large knot holes, and other irregularities, which may be corrected by the installation of heavy base flashing material or sheet metal. On buildings where steam locomotives are housed and other buildings where detrimental gases are discharged, wood roof decks should first be covered with building paper.

Equipment

In addition to the selection of the type of roofing and the proper materials to fit the specific installation, it is also requisite to provide good equipment for use in fabrication, such as a dependable hoisting kettle, preferably oil fired and equipped with high-temperature thermometer for easy reading. Flash-proof kettles are recommended as a protection against fire hazards. These kettles are now available in several sizes and will prevent fires at temperatures of 100 to 150 deg. over the normal flash point as specified by the manufacturer. As additional prevention of fire, a foam-type fire extinguisher and sand buckets should be available on all roofing jobs. (Several fires have occurred during the application of hot asphalt roofing, resulting in considerable damage to buildings.)

Asphalt should be heated to 375 to 425 deg. F. and maintained within this range of temperatures according to the slope of the roof, type of material being used, and climatic conditions. Pitch has a low melting point but a high viscosity, and may be hard to spread properly below 325 deg. F. Asphalt has a higher fluid heat point but a lesser viscosity, and should be heated to at least 375 deg. F. before use so that equal distribution of the liquid will be obtained, without a heavy deposit in any area. Great care must be taken to avoid excessive deposits of asphalt. Such deposits are objectionable on the finished surface of smooth-surface roofs since they will harden after a short time, alligator, and sometimes cause breaks in the felts. They are also a detriment in case additional top sheets are to be added at a later date.

Laying Felts

Proper laying of the felt laminations is very important. Placing of felts should follow closely behind the mop and they should be either rolled or brushed into total adherence to the next ply to aid in the elimination of blisters and buckles. Perforated felts are helpful in the elimination of blisters.

Gravel or slag-surface roofs give added protection from the elements, such as hail and windstorms, and reduce solar radiation, lowering the volatile action in the cementing medium. They also offer added protection when subject to being walked on, or to deposits of debris. One objection to the use of gravel or slag-surface roofing is the difficulty of locating and repairing leaks.

An economical type of roofing that is being used to some extent over roof decks with a slope of 1 in. to 6 in. per foot is fabricated by the application of one or two base felts nailed or mopped over the roof surface, over which a mineral-surface selvage top sheet is hot mopped. This type of roofing may be bonded or guaranteed for a period of ten years and is available in colors which may enhance the appearance of the structure.

Recent Developments

A recent development in the roofing industry is the cold process method of laying roofs, using specially manufactured roll roofing in place of the usual felts. This roofing is manufactured by saturating a dry felt with a waterproofing asphalt to provide flexibility, then coating both sides with a stabilized asphalt coating to provide weather-resisting qualities. Rolls contain 108 sq. ft. and weigh 53 lb. Two plies are required, which are bonded together by using a cold-process cement having quick setting characteristics. The finished surface is coated with a static asphalt coating. One large railroad is using cold-process roofing quite extensively on roundhouses, shop buildings and other buildings with 300 to 400 squares each. They are maintained by recoating the surface every 4 or 5 years.

Aluminum Roofing

Another type of built-up roofing developed recently involves the use of embossed aluminum sheets. Aluminum sheets 0.004 of an inch in thickness are furnished in rolls 36 in. wide by 360 ft. long, containing 1080 sq. ft. They weigh 63 lb. per roll. Application is made the same as in the use of conventional felts and with the same equipment. The specifications require the application of a 30-lb. asphalt-saturated base felt, over which two plies of embossed aluminum are hot mopped with asphalt, lapping each ply 18 in. and leaving the last ply of aluminum uncoated. The manufacturers claim for this type of roofing a reduction of 15 deg. on inside summer temperature and a reduction in roofing weight of one half to two thirds. It is also stated that this type of roofing should last 25 to 45 years. Several large industries are using this material.

Flashing

Too much importance cannot be attached to the proper application of flashing and edging. It is conservatively estimated that 75 per cent of the defects found in built-up roofs are due to failure in this phase of the work. They must be installed in conjunction with the roofing application and should be clearly covered in the specifications and detail drawings. Fabric-reinforced asbestos base flashing material has proved very effective for this class of work.

Flashing may be nailed horizontally along the upper edge on wood-frame structures and in mortar joints on masonry structures. It should then be carried down and out on the roofing and be cemented thereto. It should never be nailed to the deck when nailed to the vertical surface; conversely, when material is nailed to the roof deck do not nail it to the vertical surface. This permits contraction and expansion of the roofing and flashing under varying weather conditions without breaking the felts.

Over nails apply a 5-in. wide application of asbestos cement, into which imbed a 4-in. wide 15-lb. felt strip and cover with asbestos cement about ⅛ in. thick. This protects nail heads and prevents water infiltration. Sign supports fastened to or projecting through the roof deck should be panned in with lead containers filled with hot asphalt or pitch.

Built-up roofings are fire resistant and provide a wide range of selection as to type and finish, according to the structure involved. On gravel or slag-surfaced roofs it is desirable to apply at least 400 lb. of gravel or 300 lb. of slag per 100 sq. ft. of area, as the Fire Underwriters state that fire-resistant qualities are dependent solely on the amount of excess gravel or slag left loose on the surface.

It is recommended that the manufacturer's specifications be followed closely. Careful supervision and close inspection should be utilized in the application of built-up roofs. The manufacturer's guarantee is desirable; however, in most instances failures are the result of faulty application.

Inspection and Repairs

The time limit specified for the bonding of a built-up roof can be greatly increased by thorough periodic inspection and repairs.

In most cases it is convenient to wait until a roof is reported or found leaking, and then make only spot repairs. Unless access to the roof is provided in construction, most roofs are difficult to inspect properly. Also, railroad buildings, being located over wide areas, require much time to inspect and to supervise work.

It is recommended that a perpetual record be made for each building, showing type of roof, date installed, data on flashings and drains, and any peculiarities. At regular intervals inspections may be made and the date and findings entered on the record, together with a description of repairs made. Inspections should be made by experienced men who have a thorough knowledge of roofing and its composites, and be able to prescribe a remedy within a reasonable cost. In fact, the inspection and specification for repairs to built-up roofs may be compared to a doctor's diagnosis of a patient and prescribing the proper remedies for his ailments.

Since stresses and strains affecting the lower part of a structure can very often cause roof troubles, it is sometimes better to work from the ground up. Examine the walls, both exterior and interior, watching for cracks and signs of building movement that frequently show up at the lintels above doors and windows. Investigate all drainage facilities and look for signs of dampness that may indicate the location of the roof problem.

Finally, inspect the underside of the roof deck. Water-marked, curled or rotted boards indicate trouble on wood decks, while stains or rust spots usually mean rusted reinforcing rods due to leaks on concrete decks. On steel decks, rusted purlins, clips or welds will often lead to the source of trouble. On gypsum decks, spalling can mean a leak. Such ground work may lead directly to the weak spot, particularly on gravel or slag surface roofs, as the gravel covering conceals faults.

On the roof itself, any debris should be removed and that part of the roof that has been covered should be carefully examined. Paths of foot travel may have worn through the felts. Previous weakness, indicated by old repairs, may have reoccurred. On a tar and gravel roof, the gravel may have washed away, leaving the felts exposed; and on the smooth-surface roof, the felts may be alligatored, indicating that the sun has drawn out and evaporated the asphalt, leaving the felts dry and brittle.

Spot Repairs

In making spot repairs, under favorable temperature conditions, remove the damaged felts, clean the roof surface, nail or mop the first ply of the felt, and mop solid the remaining plies. This is not difficult on a smooth-surface roof, but on gravel or slag-surface roofs it is necessary to spud off the surface material, being careful to minimize damage to the felts. Blisters should be split open and, when dry, the felts recemented in place.

In some instances the old roofing may have deteriorated to such an extent that complete renewal is the best alternative. On smooth-surface roofs, where the surface is not in too bad a condition, two plies of 15-lb. asbestos felts (after application of primer) may be hot mopped over the old surface and the top surface finished with static roof coating, which will extend the life of the roof for several years. On a smooth-surface roof with a slope of at least one inch per foot, a mineral surface selvage cap sheet, hot mopped in place, will provide several years' service.

Smooth-surface asbestos felt roofs may be maintained by the application of a light body bituminous static roof coating. This coating should be applied about every four or five years for best results.

There are several cold applications available for coating over old composition roofs that provide an economical means of extending the roof's life. In connection with the cold application, asphalt-coated fabric should be used for repairing breaks in the surface, in the valleys and around parapet walls and flashings.

Drainage System

The roof drainage system is another source of trouble. Gutters or downspouts that are filled or broken, drains in the middle of the roof, and scuppers through parapet walls, can often cause roof leaks.

Many instances occur when roofs are reported leaking and the fault is actually in the flashings. Flashings may be defective around skylights, monitors, ventilators, valleys, parapet walls or adjoining walls, and sometimes in the copings.

Plastic roofing cement containing asbestos fibre, used with saturated fabric, is a practical material for flashing repairs. First coat the surface about ⅛ in. thick with plastic cement, allow time for plastic cement to become tacky, then apply fabric, smoothing it out firmly, and then again coat surface with plastic cement ⅛ in. thick.

Safety Precautions

Some thought should be given to safety, as roofing work is a very hazardous trade. The following practices are some well to remember: The wearing of rubber-soled shoes is an aid to prevent slipping and will prevent damage to the roof. When footing is dangerous, use safety ropes securely fastened. Do not permit men to back up when unrolling roofing. Keep loose nails off the roof. Use inspected ladders, set at an angle of approximately 70 deg. Check hoisting equipment. If the conventional cantilever tripod is used, provide sufficient sand bags for counterbalance. The use of ordinary cement buckets is dangerous, and pails properly designed to carry heavy loads of hot stuff should be provided.

A major portion of the accidents on roofing jobs are caused from burns, and a first-aid kit should be available at all times. A treatment that has been found satisfactory for asphalt and pitch burns is as follows: Clean with carbon tetrachloride and paint with one per cent of Gentian Violet solution. Gentian Violet may be applied two or three times during the first day, using a small gauze dressing. Gentian Violet is seldom used on face burns because of stain. Boric ointment, Unguentine or similar salves are all right if the burn is not serious. In case of serious burn use carbon tetrachloride and call a doctor.

Conclusion

It is the consensus of the committee that of most importance is workmanship or method of application, and in summary the following recommendations are made:

(1) Carefully select the type of roofing suitable for the surface to be covered.

(2) Provide adequate equipment for installation purposes, safety of the workmen, and the prevention of fire.

(3) Inspect and properly prepare roof decks.

(4) Provide continuous temperature control of the cementing medium.

(5) Give special attention to the installation of flashings.

(6) Arrange for periodic inspections and records of maintenance performed.

(7) Practice safety and make provision for first aid.

DISCUSSION

The discussion was opened by H. W. Routenberg (B. & O.) who declared that surface cleaning before roofing is applied is very important, and that his road applied roofing with the cold-process method, using air equipment both for the cleaning and spraying. S. White (S. P.) stated that he employed the cold-process method for applying roofing on smooth-surfaced roofs where extreme hot temperatures prevail, and that he used burlap instead of felt with good success. Mr. Routenberg said that jute, saturated with the oils used in its manufacture, had been used by his road on pier roofs. Such roofs, he said, are recoated after three or four years of service.

Guy E. Martin (I. C.) inquired if proper precautions were being taken to prevent the bonding mediums used with built-up roofs from getting into sewers and clogging them. Chairman W. H. Bunge agreed that care should be exercised to prevent bonding materials from running.

Mr. Routenberg stated that he had been experimenting with aluminum sheets as flashing material and wondered if others had had any experience with such sheets. Mr. Martin pointed out that aluminum sheets had a tendency to split when being nailed, and that it was important that all fastenings be properly protected to prevent their rusting. L. C. Winkelhaus (C. & N. W.) raised the question as to whether aluminum roof sheeting would be damaged when walked upon. However, since the use of this material is quite new, no one could give a definite answer. F. W. Hutcheson (C. & O.) stated that he had used Monel sheets for roofing and that there were no signs of rust or failure after five years of service.

Mr. Winkelhaus inquired if the bond would be waived if a railroad did repair work on a roof that was bonded for 25 to 30 years. Chairman Bunge said that the bonding company would make the repairs when required, but Mr. Winkelhaus pointed out that sometimes the railroad cannot wait until the bonding company does the work.

J. S. Hancock (D. T. & I.) warned that flashings must be carefully fastened at the edge by nailing or welding or the wind would tear them loose.

Surface Cracks

J. L. Dougherty (W. Md.) stated that the first signs of deterioration in a roof are cracks in the surface. Before applying new roofing he cleans the old surface, being careful to get the dirt out of the cracks. He then covers the crack with pieces of 15-lb. felt, laid loose, after which the top coat of 15-lb. felt is applied in the usual way with an asphalt bond. By leaving the cover strips over the cracks loose, there is less probability of the cracks working into the new top layer, he explained.

J. A. Jorlett (Penna.) expressed the opinion that the cold-process method is the safest one to use. He places a barrel pump in a 50-gal. drum of the cement and sprays the material on the roof. It is quick and safe, he said.

Mr. Hancock said it is not economically sound to apply a 20-yr. roof on 10-yr. sheathing. He also stated that galvanized nails or brads should be used and that roof decking could consist of salt-treated wood.

Prolonging the Life of Ties on Bridges and Trestles

Report of Committee

H. D. Curie (chairman), mast. carp., B.&O., Garrett, Ind.; H. Jenkins (vice-chairman), asst. div. engr., N.Y.N.H.&H., Boston, Mass.; A. F. Ainslee, b.&b. supvr., M.P., Spokane, Wash.; J. H. Babbitt, asst. div. engr., B.&O., Indianapolis, Ind.; H. A. Boehling, Jr., asst. cost. engr., C.&O., Richmond, Va.; P. B. Collier, b.&b. supvr., M.P., St. Louis, Mo.; F. H. Cramer, br. engr., C.B.&Q., Chicago; P. E. Dale, supvr. b.&b., N.Y.C. Sys., Indianapolis, Ind.; L. J. Deno, off. mgr., C.&N.W., Chicago; W. R. Jackson, asst. eng., M.St.P.&S.S.M., Stevens Point, Wis.; R. L. Lewis, b.&b. supvr., B.A.&P., Anaconda, Mont.; F. J. Meyer, ch. engr., Ry. Prod. Div., Phila. Steel & Wire Corp., Chicago; B. J. Ornburn, eng. & supt. b.&b., C.M.St.P.&P., Chicago; G. W. Neal, supt., Chatt. Val., West Point, Ga.; S. H. Shepley, asst. ch. engr., E.J.&E., Joliet, Ill.; J. P. Witherspoon, asst. mast. carp., S.A.L., Atlanta, Ga.; O. W. Stephens, asst. engr., br. & struc., D.&H., Albany, N.Y.; L. W. Watson, reg. br. insp., B.&O., Pittsburgh, Pa.; H. G. Lord, b.&b. mast., C.P.R., Kenora, Ont.

THIS IS becoming a more important subject every day for the consideration of supervisory forces in bridge work. It is very important in the matter of conservation of our natural resources as the available supply of good timber is becoming depleted at an alarming rate. The cost of bridge ties installed is a very important item in the maintenance of bridges.

The first important step to be taken by supervisory forces is the proper maintenance of existing decks. Many years can be added to the life of a deck by prompt action to remedy defects in a deck as soon as they develop. Once a defect develops in a deck, such as a crushed or split tie, additional stress is thrown on adjacent ties and they, in turn, become damaged. In decks that have a large percentage of good ties, a defective tie should be renewed promptly to avoid damage to the remainder of the ties.

Ties with longitudinal splits can sometimes be saved by bolting the pieces together. Surface defects caused by plates cutting into ties can be corrected by the use of an iron filing compound under the plate where plate is pocketed, or the use of a hardwood shim. Spikes which become loose should be removed and the holes plugged with treated tie plugs before spikes are redriven.

In the event that it becomes necessary to renew a number of failed ties in a deck that shows mechanical wear and crushing under tie plates, it is considered good practice to renew a certain number of ties out-of-face on one end of the deck, and use the salvaged ties to replace defective ties in the remainder of deck. This gives a better riding condition than is obtained when new ties are spotted in among ties which have crushed or softened under plates. Ties that become badly checked or split can be saved from decay by filling checks or cracks with tar or plastic compound.

The life of a deck can be extended materially by the maintenance of good line and surface on the bridge and approaches. This feature should be checked at periodic intervals and any defects found corrected promptly.

Good maintenance of rail joints is very essential to the life of ties, as loose or battered joints will soon cause ties to be damaged by mechanical wear. Once mechanical wear starts it presents a formidable problem to overcome.

Fire Prevention

The fire losses resulting from fires on bridge decks amount to more than one million dollars a year in the United States. Fire losses can be greatly reduced by the use of sheet metal coverings over decks. In some cases an asphaltic base compound has been spread on the ties and then covered with a coating of sand, stone screenings or fine gravel. It has been found that ties which have been coated with the various compounds, will resist fire action much better than ties which have not been coated. In the event a fire should start on a deck thus treated, the rate of burning is much slower in the coated ties.

The use of metal or asbestos cement board as fire stops at intervals on the longer decks has been successful in reducing fire damage.

In older decks, where shattering of the grain of ties starts, these surfaces should be adzed smooth. Bad checks and splits should be filled with an asphalt compound and covered with sand or gravel. On creosoted decks, where extremely hot weather causes the oil to boil to the surface of the tie, dry cement swept or dusted on these surfaces will usually form a slightly hard protective coating which is fire resistant. A tie with heavy creosote treatment is very susceptible to fire damage and will burn rapidly.

The use of salt solutions in the treatment of bridge ties has been tried as an aid to fire prevention. Ties thus treated are much more resistant to fire and have a much slower burning rate than those treated with creosote solutions. Although the salt-treated tie is much more fire resistant, the life of such ties is only about one-half the life of creosoted-treated ties. This is due to leaching of the salts.

The use of creosote solutions for the treatment of ties has proven more successful than any other treatment from the standpoint of life in years, even though the fire risk is greater.

There are treated decks that have to be renewed which will yield enough good salvage ties to renew decks on unimportant bridges and trestles on branch lines where traffic is light and movements slow. These ties can be reframed and will give a number of years of service, although, generally speaking, secondhand salvage ties can be used as cribbing, blocking, etc., to much better advantage.

When it becomes necessary to renew a deck of ties, consideration should be given to taking care of any steel repairs to cover plates, lateral plates and angles, or any other repairs which would necessitate the moving of ties, etc., as this is usually injurious to the ties.

Inaccessible parts of a bridge under ties should also be thoroughly cleaned and painted before placement of the new deck. If this work is done there will be very little necessity for disturbing the ties for a number of years.

It is a well-known fact that the line and surface of the track on the bridge and approaches have considerable bearing upon the life of a deck. This is particularly true of the approaches, for if the track is not kept well tamped on the approaches, it will only be a short time until the backwall tie and end ties on the bridge will show considerable mechanical wear and crushing; also, if the line is poor, there will be a tendency for the tie plates to cut into the tie and for the spikes to become loose.

When steel repairs, cleaning and painting are completed, the bearings for the ties must be brought up to a true surface. Bearing surfaces on masonry should be checked and any necessary repairs made.

The alignment of track over a bridge should be thoroughly checked and the track relined, if necessary. The best results are obtained by using an instrument and correcting the line before the new ties are placed, as there is a tendency to slight the line if this is done at the time new ties are placed. Also, considerable traffic delay can result by trying to correct line at the time new ties are placed.

Timber Requirements

The first important step is the selection of timber for use as bridge ties. Timber should preferably be straight grained, free of large knots, shakes, and splits. It should be well seasoned before treatment. Hardwood has a tendency to split and check more easily than softwoods. The use of variously shaped irons driven into the ends of ties tends to reduce splitting. Much of the trouble experienced recently by short life in bridge ties has been due to the lack of adequate seasoning of the timber before treatment. Timber not fully seasoned and containing moisture will not last much longer after treatment than untreated timber which has been fully seasoned before use.

All timber for ties should be well seasoned and treated, as an untreated tie, or one improperly treated, with a life of 10 years, is much more expensive than a treated tie with a life of 20 years or more. The labor cost of installation is practically the same for either kind of tie.

The size and spacing of the tie are very important factors. An under-sized tie will develop checks, splits and crushing at bearings. Inadequate bearings will increase mechanical wear. The depth of a tie depends upon the distance of center to center of bearing points. The greater the distance, the deeper the tie that will be needed. On bridges where there are several cover plates that do not extend the full length of the span, ties of different depth should be used instead of having deep daps on one size of tie. Deep daps in ties tend to cause shear cracks and splitting on the underside of the ties. Where elevation ties are used on curves, the daps should be parallel with the grain. The width of the tie should not be greater than the width of tie plate. With wide ties, water pockets develop under the plates.

The treatment of ties has made possible the use of softer woods. Formerly, before treating became general, the life of softwood ties and ties with heavy sapwood was very short due to decay and mechanical wear. Treatment has more than doubled the life of such ties, although they are still susceptible to mechanical wear. Generally speaking, the use of such ties is much more satisfactory on timber trestles, where they have more bearing surface, than on steel bridges. This reduces the mechanical wear to the area under tie plate. This can be further reduced by the use of longer and heavier plates.

One of the important steps in preparing a tie for treatment is proper seasoning. The vapor-drying process of seasoning is supposed to reduce the amount of checking and splitting, in addition to eliminating the long seasoning period. If this method is proved commercially successful it will eliminate the stacking of ties for long seasoning periods.

Preframing

When it becomes necessary to renew a deck, measurements should be taken in the field and furnished the treating plant for the proper framing before treatment. Where the bearings of ties and center line of track are in exact relation, the ties should be prebored for spikes. Reports indicate that in numerous instances, the relation between tie bearings and center line of track is such that good line can not be obtained by preboring before treatment. Usually, ties used on trestles can be prebored.

On bridges where there are rivet heads on the bearings, the ties, especially hardwood, should be predapped for the rivet heads. Where there are more than two lines of rivets on a bearing, unless the bearing is extra wide, ties should not be predapped for rivets as too much bearing surface would be lost. In this case the ties should be bored in the field for rivet heads or allowed to seat under traffic. There is some objection to seating hardwood ties on rivets under traffic on account of loosening rivets.

Timber guard rails can either be framed and prebored before treatment or this work can be done in the field. If done in the field proper precaution should be taken to see that holes are treated and joints painted with creosote oil. Generally the dapping of timber guard rail has been eliminated by the use of fastenings between the ties and guard rail.

In placing new ties on bridges or trestles, great care should be exercised in the handling of them so that they are not dropped and become badly bruised or split. The use of maul on ties to seat them should be prohibited. Ties should be placed in proper position before spiking or fastening guard rails. Ties that are improperly placed, or tie plates and rail not lined before spiking, will result in fastenings having to be removed to correct these conditions. Whenever spikes have to be redriven in ties, even though the holes are properly plugged, the life of the tie is generally shortened by several years.

Mechanical Wear

Mechanical wear under tie plates and the resultant decay around the spikes, take the greatest toll of bridge ties. If this can be eliminated, many years can be added to the life of ties. In recent years a number of tie pads have been placed on the market for use between ties and tie plates. It is claimed that these pads reduce abrasive action, cushion impact loads, thereby reducing splits and checks in the ties, and assist in maintaining true line. Net savings of 25 to 100 per cent of installed cost of bridge ties are claimed. These pads have not generally been under actual test long enough for the results to be conclusive. Reports indicate that some pads are too hard and show considerable wear in a few years. Others tend to shatter and absorb moisture rather than resist it. Reports indicate that a pad of somewhat tacky composition will form a better seal around spikes, also between plate and tie, thereby keeping out moisture. A pad of this type should prove to be more beneficial than harder types of pads.

Briefly, the main points to be considered in prolonging the life of bridge and trestle ties are as follows:

(1) Necessary repairs to tie bearings before replacement of the ties.
(2) Good grade of timber, preframed and treated.
(3) Properly placed in true line and surface.
(4) Well fastened to prevent movement.
(5) Proper maintenance of the approaches.
(6) Frequent inspection for crushing, splitting, decay and condition of line and surface.
(7) Prompt action to remedy defects.
(8) Proper fire protection maintained.

The life span of a bridge or trestle tie is largely determined by the quality of material, workmanship and maintenance. Poor material, workmanship and maintenance result in a very short life. Good quality material, workmanship and maintenance will result in a much longer and more satisfactory life span. This is the responsibility of bridge supervision.

DISCUSSION

H. M. Harlow (C. & O.) raised a question regarding the use of tie pads for lengthening the life of ties. M. Block (I. C.) stated that tie pads had proved very effective on his road and cited an example of their use on a bridge where the ties had become badly cut by the tie plates. The bridge was that over the Ohio river at Cairo, Ill., which is located on a 4-deg. 45-min. curve. Since tie pads were installed more than five years ago, the ties show no apparent change, said Mr. Block. T. M. von Sprecken (Sou.) said his road is experimenting with tie pads but that they have not been in service long enough to determine their merits.

F. G. Campbell (E. J. & E.) took issue with the statement in the report that "timber not fully seasoned and containing moisture will not last much longer after treatment than untreated timber which has been seasoned before use," saying he believes that even green timber, when treated, will last longer than untreated material.

Chairman Curie stated that one member of his committee wanted the report to recommend the use of lag screws as anchor spikes to reduce mechanical wear of ties. However, the committee as a whole was of the opinion that this practice was too expensive to recommend. J. A. Jorlett (Penna.) said his road changed from lag screws to drive spikes because it was found that the men were using the screw spikes the same as drive spikes.

Developments in Modern Methods for Watering Passenger Coaches

Report of Committee

W. D. Gibson (chairman), w.s. engr., C.B.&Q., Chicago; T. M. von Sprecken (vice-chairman), asst. to ch. engr., Sou., Washington, D.C.; H. M. Dick (vice-chairman), mast. carp., Penna., Columbus, Ohio; W. F. Armstrong, arch. drafts., C.&N.W., Chicago; W. W. Caines, asst. supvr. b.&b., C.&O., Huntington, W. Va.; E. F. Cook, wat. sta. fore., M.P., Little Rock, Ark.; L. A. Cowsert, wat. insp., B.&O., Dayton, Ohio; H. E. Davis, b.&b. supvr., N.Y.C. Sys., Chicago; R. W. Gilmore, gen. br. insp., B.&O., Cincinnati, Ohio; A. B. Hillman, asst. ch. engr., C.&W.I.-Belt, Chicago; A. S. Krefting, prin. asst. engr., M.St.P.&S.S.M., Minneapolis, Minn.; G. E. Martin, supt. wat. ser., I.C., Chicago; J. K. Murdock, vice-pres., Murdock Mfg. & Sup. Co., Cincinnati, Ohio; L. C. Smith, div. engr., C.&N.W., Madison, Wis.; J. Sumner, wat. stat. fore., St.L.-S.F., Springfield, Mo.; W. L. Turner, east. engr. ed., Railway Age., New York; J. W. McGarry, pres., R.R. Prod. Co., Cincinnati, Ohio.

THE SUBJECT for consideration in this report is of much concern to most railroads. There has been a concerted effort during the past few years by public health agencies, including the U. S. Public Health Service and various state and municipal bodies, toward the improvement of sanitation in public places and conveyances. That these efforts have produced results seems evident, as statistics will show that over a corresponding period of years there has been a marked reduction in typhoid, dysentery, and other diseases known to be caused by water-borne bacteria. For a number of years of this period, some railroad men looked on the effort to control the sanitation of railroad facilities as more or less of a nuisance, and only in recent years has the importance of such efforts been realized by all.

The Federal Health Service, in conjunction with various committees of railroad officers, have promulgated a manual which sets forth desired standards that should be followed in order that a safe water supply might be delivered to passenger cars and other conveyances in interstate traffic. The current manual is a publication known as "Sanitation Manual for Land and Air Conveyances Operating in Interstate Traffic," Reprint No. 2444, dated Jan. 29, 1943. In this manual there is a discussion of various types of water delivery facilities, as well as suggested arrangements in the areas where cars are to be serviced and relating to the handling of hose and other servicing equipment.

Delivery Systems

In the manual, as well as in regulations which have been set forth by many of the individual states, the overhead system of water supply, which eliminates any possibility of ground contamination, is given preference. However, most watering points on the railroads have long been established, and track centers in yards are such that an overhead system is more or less prohibitive without excessive expenditures.

A few such installations have been made where conditions permitted. One railroad in the Chicago terminal area has recently made an overhead installation wherein the water line was encased in a metal jacket together with a steam line supported overhead on metal posts. Drops to service outlets were made at 75-ft. intervals, with the valves at the top, and with extended operating handles conveniently located and attached to the supporting posts. Track centers approximated 30 ft. This installation is reported to be working satisfactorily and has received favorable comment from the interested authorities.

Post-type hydrants served by underground supply, without sub-grade drain openings, are also given preference. Underground drainage connections of any sort are frowned upon unless they are connected to an individual drainage system used exclusively for the drainage from the hydrants, and are so arranged that the outlet, either by gravity or pumpage, is entirely free from the possibility of any contact with contaminated water.

Hydrant Drainage

It is assumed that all necessary precautions have been taken to be sure that a safe supply is available up to the structure through which the water is to be delivered to the car. From this point on, decided improvements have been considered necessary. Most railroads, particularly those operating in northern climates where freezing weather is encountered, find it necessary to use a type of coach-watering hydrant which will permit drainage of the riser pipe after the valve has been closed. Generally the drainage from the bottom of these hydrants has been either to surrounding ground or to a sewer or drain.

Early in the study of the possibility of preventing the contamination of water supplies, it was determined that the most prolific source of such contamination was from bacteria entering the water stream through the drainage or weep holes of the hydrant valves. Some might question how water from contaminated sources can gain access to a pipe line that is under pressure. Such, however, is readily possible as a result of syphonage produced by a vacuum in the supply line, which could be created by repair work or possibly heavy pumpage in the vicinity in case of a fire. Also, it has been clearly demonstrated that an aspiration effect can take place when a stop and waste valve is in the forward flow position, and could be drawing some of the surrounding, and possibly contaminated, water into the ports of the valve.

Inasmuch as the greatest stress in the attempt to improve watering facilities has been placed on the elimination of the possibility of underground contamination, many of the manufacturers of ground-type hydrants have developed and are continually experimenting with hydrants which eliminate the need for an underground drainage connection.

The need for improvement in coach-watering hydrants and attendent accessories has been further increased by the accelerated program of modernization of passenger train equipment that has taken place during the past few years. Train schedules have been speeded up, and it has become more important that facilities, particularly at intermediate points, be available to service trains quickly with drinking water. In many cases larger tanks have been installed on the newer passenger cars to reduce the number of times during a trip that it may be necessary to replenish the water supply. For example, on two groups of new trains recently constructed, water storage tanks holding over 500 gal. have been installed, compared with tanks of about 150 gal. capacity on older conventional cars. This makes it mandatory that, to fill these storage tanks in minimum time, and thus avoid delays to trains, larger capacity watering equipment be provided.

On the new trains referred to, it was decided to provide zeolite-softened water for lavatory purposes. To obtain the approval of the Public Health Service for such an installation, it was necessary to provide an auxiliary tank connected to the main supply tank but with outlets only to the lavatories. The treatment is provided by zeolite contained in nylon bags, and the regeneration is done by the removal of these bags at the end of the trip.

New Developments in Hydrants

Among the more recently developed types of coach-watering hydrants devised to eliminate underground drainage connections are those which operate on an ejector basis, in which drainage from the riser pipe of the hydrant is collected in an underground tank attached to the hydrant, and then ejected at the subsequent use of the hydrant. Many hydrants of this type have worked out quite satisfactorily when operated properly. However, there have been cases where it was necessary to use longer lengths of hose than was recommended by the manufacturers, with the result that the ejector principle did not prove entirely satisfactory and freezing of the hydrants resulted.

The type of hydrant employing the old principle of heating the riser pipe has come into more prominent use recently. This involves the use of an outer pipe casing, with an insulating material and an electric strip heater surrounding the riser pipe. Any number of hydrants, from one up to seven or eight, can be controlled by one thermostat centrally located, permitting any desired temperature.

Another method developed recently, and so far applicable only to post-type hydrants, consists of an expandable section of a rubber compound riser tubing inside of a larger metal pipe, which permits freezing without destruction of any equipment. The idea behind this design is that if freezing does occur in the riser tubing, when the hydrant is turned on the ice either melts or is discharged from the outlet which terminates in a long arc especially for the purpose. Several of these hydrants have been installed in an experimental manner and fairly satisfactory results are reported.

Still another innovation, not as yet thoroughly tested, is the use of two riser pipes instead of one; these pipes being of different diameters, and tending by circulation to prevent freezing. This method presumably would work more satisfactorily where the hydrants are directly and closely connected with a single supply line in which the water is moving most of the time.

Another method which has been reported utilizes air pressure to activate the valve and shut off the water and remove the water from the pipe near the surface so as to prevent freezing.

Platform-Type Hydrants

Practically all of the types of hydrants referred to above have been constructed as post-type hydrants and have not added a great deal to solving the problems of many railroads where it is necessary to use platform and flush-type hydrants at intermediate stations where track conditions are such that it is impossible to use post-type hydrants. It is quite possible, however, that certain adaptations of the newer arrangements can be worked out so that the platform hydrants can be retained where necessary.

In several cases which have come to our attention, roads have separated drainage from a group of existing platform hydrants and have diverted it into a sump in which was installed an automatically operated sump pump. This pump discharges the drainage water through an air gap into an existing storm sewer. This arrangement, adapted from an existing drainage system, has proved very satisfactory and was installed quite economically. A new system built along this line would probably be of exhorbitant cost.

One decided improvement has been made in connection with more recent installations of post-type hydrants, wherein some rather ingeniously designed hinged covers have been developed which automatically drop when the hose is removed, protecting the outlet against splash from surrounding sources.

Hose

There have not been many new developments involving the hose which is used in watering cars. Perhaps this is partially due to the fact that there are so many different types of car connections. The discharge end of the hose is required to be protected by a disc, which is intended to prevent the nozzle from coming in contact with contamination from the ground or platforms.

There is a new type of disc which has likelihood of demonstrating value. It is in the shape of a truncated cone with an outside diameter of only about four inches, and with the large diameter around the nozzle outlet.

Some experimentation has been done with a spring-loaded cap to fit over the end of the hose nozzle, and attached by a chain to the disc itself. This arrangement seems to have merit, as does a section of white gum rubber hose for use as a nozzle beyond the protective disc. This flexible nozzle is of value where slip-on connections are made to cars, and also for insertion in underslung tanks.

In conclusion, attention is called to the fact that the use of any of the newer watering devices should first be cleared with local and state health authorities and, if necessary, with the federal people. It is generally not the practice to give blanket approval to any device, but rather to consider each installation on its merits, as certain types of hydrants are approved in many states and are not permissible in others.

DISCUSSION

Chairman Gibson began the discussion by saying that, although the committee report was prepared in cooperation with Mr. Darby of the Sanitary Engineering division of the United States Public Health Service in Washington, he wanted to stress that part which states that no general plan or layout can be set up as a model for all installations, because the Washington office insists upon considering each installation separately. In general, Mr. Gibson said, the federal authorities will go along in approving a proposed installation if the state authorities have approved it first.

G. Walker (M.P.) said he had found the state authorities very cooperative and accommodating. When his railroad presented plans for hydrant installations which didn't quite meet the specifications, the state authorities would advise what changes were required to make them satisfactory.

President Barnhart said that, of 69 hydrants that he is installing, all but five are of the platform type, and it is this type that the federal authorities are most reluctant to approve. Also, he said, because of the speed with which trains must be serviced and the large-capacity tanks which must be filled, it is imperative that hydrants of a larger size be manufactured.

Safety in Transportation of Men and Materials

Report of Committee

J. M. Giles (chairman), asst. engr., M.P., St. Louis, Mo.; N. H. Williams (vice-chairman), b.&b. supvr., D.&H., Oneonta, N.Y.; E. H. Blewer (vice-chairman), supvr. saf. eng., N.Y.C. Sys., New York; R. D. Bisbee, div. engr., P.&S.F., Slaton, Tex.; O. H. Blankenship, w.s fore., M.P., Poplar Bluff, Mo.; S. L. Chapin, safety supvr., So. Pac., San Francisco, Cal.; W. D. Conrad, mast. carp., Penna., Pittsburgh, Pa.; G. S. Crites, div. engr. (ret.), B.&O., 4409 Underwood rd., Baltimore, Md.; H. D. Curie, mast. carp., B.&O., Garrett, Ind.; R. L. Fox, div. engr., Sou., Alexandria, Va.; A. M. Glander, ch. carp., C.M.St.P.&P., Mason City, Iowa; J. J. Healy, asst. b.&b. supvr., B.&M., Boston, Mass.; A. C. Jones, b.&b. supvr., Sou., Jasper, Ala.; J. R. Leguenec, Jr., b.&b. supvr., St. L. S.W., Tyler, Tex.; H. J. Lieser, trk. supvr., Belt Ry., Chicago; A. G. Reese, dist. maint. engr., C.B.&Q., Galesburg, Ill.; G. R. Webb, ch. carp., C.M.&St.P.&P., Spokane, Wash.; W. F. Raley, mast. carp., B.&O., Pittsburgh, Pa.

THIS SUBJECT will be treated from the standpoint of transporting the forces and materials used in maintenance-of-way and structures work. The evolution of present-day vehicles for the transportation of men and materials is familiar to those whose experience dates back to the 1900's and to those who read reports and articles such as this. The three types of transportation considered in this report are:

(1) Work trains
(2) Motor cars, push cars and trailers
(3) Automotive vehicles

Work Trains

The cardinal rule to instill in the minds of all those whose duties lie in or about work trains is that there must be a central head to direct the movement. The roadmaster, bridge supervisor, or foreman in charge must first establish with members of the train and engine crews that:

(a) All signals for movement of the work train must be given by a member of the train crew after an understanding with the Supervisor in charge or his delegated representative.

(b) Sufficient foremen or representatives must know that all men under their supervision are in places of safety before the signal is given to move the train.

Safe work-train performance from the standpoint of the maintenance-of-way forces depends upon planning and a mutual understanding as to what work will be done.

Material to be transported by work train must be loaded in a secure manner. Close study of the loading rules applying to company material will pay dividends. It is up to the supervisor to follow these rules carefully when company material is loaded for train haul. Personal injuries and damaged structures result when one assumes that company material is not subject to shifting and other conditions which create a hazard of accident.

Roadway machines must be blocked

when loaded, and loading rules followed to insure safe handling in train haul. Time spent in securing loads with wire and stakes is well spent. The material and labor involved in securing loads are cheap compared with the disruption of traffic and personal injuries that might result from improper loading.

Motor Cars, Push Cars and Trailers

It is presumed in this discussion that motor cars, push cars and trailers are given authority to occupy operated tracks by management through the use of appropriate rules.

Requirements of operation must be met with a "must do" attitude. One who violates rules is substituting his judgment for the judgment and experience of 100 years of railroad experience bound in a book called "Rules."

The selection of motor cars for various types of work is the result of careful study. Changing cars to a type of service other than that originally assigned requires judgment. Overloading and insufficient braking power are factors contributing to motor-car accidents.

Transporting Men

Men being transported by motor car and trailers must be provided with seating space. The transportation of men on push cars, whether light or loaded, is conducive to accident. Speed in excess of that prescribed by the rules is a nemesis of all safety-minded men. There is no "short time" on a railroad. One either has time to go to a certain point at a certain speed, as prescribed by the rules, or has the alternative of staying off the track until he does have that margin of time to complete his journey safely.

The requisite for safe transportation of men and materials by motor car, push car and trailer is strict compliance with rules of the service. Understanding and correction of material defects by a competent inspector, and follow-up to see that the defects are corrected before the vehicle resumes operation, comprise a "must" procedure.

Automotive Vehicles

The automotive vehicle is one of the newer means for the transportation of men and materials in maintenance-of-way service. Like other machines, man must be master of it, or it becomes an enemy to safe operation.

Automotive vehicles assigned to maintenance-of-way service must be carefully selected for the type of service intended. Operators of such vehicles must be selected for their mature judgment and a sense of responsibility for the safety of those entrusted to their care. Knowledge of customs, laws and conditions peculiar to operating location are necessary for safe operation.

Vehicle inspection reports that burden the operator and supervisor with unnecessary data are worthless. Inspection reports must be concise, direct, and the result of an actual inspection of a vehicle by a qualified inspector. Defects as noted by the inspector must be corrected before a vehicle is returned to service.

The foreman in charge of truck operations must be versed in the rules for loading vehicles for highway transportation. Legal requirements as to weight, height, and width must be known and complied with.

Seating Arrangements

As in work-train and motor car operation, an understanding must be had between the operator and the man in charge before the vehicle is moved. Seating space must be provided for all men being transported by automotive vehicle. The practice of permitting limbs to protrude over the end gates and sides of vehicles sets up a potential hazard of accident.

Over driving lights are responsible for most accidents occurring after sunset. Frequent contact with automotive vehicle manufacturers and service men will be beneficial. New methods of operation and new safety devices are being provided for vehicles and it is well to keep abreast of these changes in order to benefit from the experience of others.

Conclusions

The foregoing is a summation of some of the experiences of men engaged in the transportation of men and materials engaged in the maintenance of way and structures on American railroads.

Safety from the many angles of railroading is the result of careful programming of the work involved, and close contact between the supervisor and men engaged in the work. The open-door policy between supervisor, foremen and men invite a free discussion of the problems confronting all railroad supervisors today. Many suggestions, after careful weighing, are discarded. However, out of the suggestions made, one may be adopted which will result in a "better working-day home" for employees engaged in maintenance-of-way service on the railroads.

DISCUSSION

The discussion was begun by J. R. Showalter (M.P.) who cited an instance where several men were hurt when their motor car was run over a railroad grade crossing at more than 15 m.ph.

J. L. Holmes (N.Y.N.H.&H.) raised the question whether it is the custom on other roads to keep the tailboard up on trucks when carrying men. He said his road permitted the tailboard to be down but that a safety chain was provided to prevent men from falling off. T. M. von Sprecken (Sou.) said he was not in favor of letting men ride on vehicles with their feet hanging down in the rear or with their arms out. He added that men on his road are not permitted to ride motor-car trailers when they are being pushed, nor are they permitted to ride on a water barrel being carried on a push car. He emphasized that foremen must enforce prevailing safety rules or the men would fall into unsafe habits.

P. F. Huston (C.&S.) said that on his road there is a rule against running motor cars backwards at speeds in excess of 5 m.p.h. and that the operation of cars in reverse was permissible only when moving to set-offs. President Barnhart stated that backing up a motor car is a dangerous practice. He cited an instance where a water keg fell off while this was being done, derailing the car and causing five men to be hurt.

Chairman Giles stated that only one truck out of the 16 assigned to him had been involved in an accident. Guy Martin (I.C.) added that experience with trucks on his road showed that the panel-type truck was not as safe as the open-top type. Mr. Holmes stated that he preferred trucks to motor cars because of their greater convenience and speed in getting out to the location of the job.

Mr. Huston suggested that the committee report be revised to state that any person may give a "stop" signal when controlling train movements, but that only a member of the train crew should be authorized to give the "proceed" signal. W. H. Vance (M.P. retired) said that he agreed with Mr. Huston, but that he had found that the supervisors were the greatest offenders in violating this safety concept. He believes that they should comply with this understanding and thus set an example for the foremen. G. J. Bass (G.C.&S.F.) stated that he was not in accord with Mr. Huston and that he believes foremen and not the trainmen should give the signals, particularly when spotting a pile driver for driving piles. Mr. Huston replied by saying that, even for this operation, it would be more desirable to have only a trainman give the signals as directed by the foreman.

	1891-2	1892-3	1893-4	1894-5
President	O. J. Travis	H. M. Hall	J. E. Wallace	Geo. W. Andrews
1st V.-Pres.	H. M. Hall	J. E. Wallace	Geo. W. Andrews	W. A. McGonagle
2nd V.-Pres.	J. B. Mitchell	G. W. Hinman	W. A. McGonagle	L. K. Spafford
3rd V.-Pres.	James Stannard	N. W. Thompson	L. K. Spafford	James Stannard
4th V.-Pres.	G. W. Hinman	C. T. Fuller	E. D. Hines	Walter G. Berg
Secretary	C. W. Gooch	S. F. Patterson	S. F. Patterson	S. F. Patterson
Treasurer	George M. Reid	George M. Reid	George M. Reid	George M. Reid
Executive Members	W. R. Damon	G. W. Andrews	Q. McNab	James Standdard
	G. W. Markley	J. M. Staten	A. S. Markley	James H. Travis
	W. A. McGonagle	J. M. Caldwell	Floyd Ingram	J. H. Cummin
	G. W. McGehee	Q. McNab	James Stannard	R. M. Peck
	G. W. Turner	Floyd Ingram	James H. Travis	J. L. White
	J. E. Wallace	A. S. Markley	J. H. Cummin	A. Shane

	1895-6	1896-7	1897-8	1898-9
President	W. A. McGonagle	James Stannard	Walter G. Berg	J. M. Cummin
1st V.-Pres.	L. K. Spafford	Walter G. Berg	J. H. Cummin	A. S. Markley
2nd V.-Pres.	James Stannard	J. H. Cummin	A. S. Markley	C. C. Mallard
3rd V.-Pres.	Walter G. Berg	A. S. Markley	G. W. Hinman	W. A. Rogers
4th V.-Pres.	J. H. Cummin	R. M. Peck	C. C. Mallard	J. M. Staten
Secretary	S. F. Patterson	S. F. Patterson	S. F. Patterson	S. F. Patterson
Treasurer	George M. Reid	N. W. Thompson	N. W. Thompson	N. W. Thompson
Executive Members	R. M. Peck	W. O. Eggleston	G. J. Bishop	Wm. S. Danes
	J. L. White	W. M. Noon	C. P. Austin	J. H. Markley
	A. Shane	J. M. Staten	M. Riney	W. O. Eggleston
	A. S. Markley	G. J. Bishop	Wm. S. Danes	R. L. Heflin
	W. M. Noon	C. P. Austin	J. H. Markley	F. W. Tanner
	J. M. Staten	M. Riney	W. O. Eggleston	A. Zimmerman

	1899-1900	1900-1901	1901-1902	1902-1903
President	Aaron S. Markley	W. A. Rogers	W. S. Danes	B. F. Pickering
1st V.-Pres.	W. A. Rogers	W. S. Danes	B. F. Pickering	C. C. Mallard
2nd V.-Pres.	J. M. Staten	B. F. Pickering	A. Shane	A. Shane
3rd V.-Pres.	Wm. S. Danes	A. Shane	A. Zimmerman	A. Zimmerman
4th V.-Pres.	B. F. Pickering	A. Zimmerman	C. C. Mallard	A. Montzheimer
Secretary	S. F. Patterson	S. F. Patterson	S. F. Patterson	S. F. Patterson
Treasurer	N. W. Thompson	N. W. Thompson	N. W. Thompson	N. W. Thompson
Executive Members	T. M. Strain	T. M. Strain	A. Montzheimer	W. E. Smith
	R. L. Heflin	H. D. Cleaveland	W. E. Smith	A. W. Merrick
	F. W. Tanner	F. W. Tanner	A. W. Merrick	C. P. Austin
	A. Zimmerman	A. Montzheimer	C. P. Austin	C. A. Lichty
	H. D. Cleaveland	W. E. Smith	C. A. Lichty	W. O. Eggleston
	A. Montzheimer	A. W. Merrick	W. O. Eggleston	J. H. Markley

	1903-1904	1904-1905	1905-1906	1906-1907
President	A. Montzheimer	C. A. Lichty	J. B. Sheldon	J. H. Markley
1st V.-Pres.	A. Shane	J. B. Sheldon	J. H. Markley	R. H. Reid
2nd V.-Pres.	C. A. Lichty	J. H. Markley	R. H. Reid	J. P. Canty
3rd V.-Pres.	J. B. Sheldon	R. H. Reid	R. C. Sattley	H. Rettinghouse
4th V.-Pres.	J. H. Markley	R. C. Sattley	J. P. Canty	F. E. Schall
Secretary	S. F. Patterson	S. F. Patterson	S. P. Patterson	S F. Patterson
Treasurer	C. P. Austin	C. P. Austin	C. P. Austin	C P. Austin
Executive Members	R. H. Reid	W. O. Eggleston	H. Rettinghouse	W. O. Eggleston
	W. O. Eggleston	A. E. Killam	A. E. Killam	A. E. Killam
	A. E. Killam	H. Rettinghouse	J. S. Lemond	J. S. Lemond
	R. C. Sattley	J. S. Lemond	C. W. Richey	C. W. Richey
	H. Rettinghouse	W. H. Finley	H. H. Eggleston	H. H. Eggleston
	J. S. Lemond	C. W. Richey	F. E. Schall	B. J. Sweatt

	1907-1908	1908-1909	1909-1910	1910-1911
President......	R. H. Reid	J. P. Canty	H. Rettinghouse	H. Rettinghouse
1st V.-Pres....	J. P. Canty	H. Rettinghouse	J. S. Lemond	F. E. Schall
2nd V.-Pres....	H. Rettinghouse	F. E. Schall	F. E. Schall	A. E. Killam
3rd V.-Pres....	F. E. Schall	J. S. Lemond	A. E. Killam	J. N. Penwell
4th V.-Pres....	W. O. Eggleston	A. E. Killam	J. N. Penwell	L. D. Hadwen
Secretary......	S. F. Patterson	S. F. Patterson	C. A. Lichty	C. A. Lichty
Treasurer......	C. P. Austin	C. P. Austin	J. P. Canty	J. P. Canty
Executive Members	A. E. Killam	J. N. Penwell	W. Beahan	T. J. Fullem
	J. S. Lemond	Willard Beahan	F. B. Scheetz	G. Aldrich
	C. W. Richey	F. B. Scheetz	L. D. Hadwen	P. Swenson
	T. S. Leake	W. H. Finley	T. J. Fullem	G. W. Rear
	W. H. Finley	L. D. Hadwen	G. Aldrich	W. O. Eggleston
	J. N. Penwell	T. J. Fullem	P. Swenson	W. F. Steffens

	1911-1912	1912-1913	1913-1914	1914-1915
President......	F. E. Schall	A. E. Killam	J. N. Penwell	L. D. Hadwen
1st V.-Pres....	A. E. Killam	J. N. Penwell	L. D. Hadwen	G. Aldrich
2nd V.-Pres....	J. N. Penwell	L. D. Hadwen	G. Aldrich	G. W. Rear
3rd V.-Pres....	L. D. Hadwen	T. J. Fullem	G. W. Rear	C. E. Smith
4th V.-Pres....	T. J. Fullem	G. Aldrich	C. E. Smith	E. B. Ashby
Secretary......	C. A. Lichty	C. A. Lichty	C. A. Lichty	C. A. Lichty
Treasurer......	J. P. Canty	J. P. Canty	J. P. Canty	F. E. Weise
Executive Members	G. Aldrich	G. W. Rear	W. F. Steffens	W. F. Steffens
	P. Swenson	W. F. Steffens	E. B. Ashby	S. C. Tanner
	G. W. Rear	E. B. Ashby	S. C. Tanner	Lee Jutton
	W. F. Steffens	C. E. Smith	Lee Jutton	W. F. Strouse
	E. B. Ashby	S. C. Tanner	W. F. Strouse	C. R. Knowles
	W. O. Eggleston	Lee Jutton	C. R. Knowles	A. Ridgway

	1915-1916	1916-1917	1917-1918	1918-1919
President......	G. W. Rear	C. E. Smith	S. C. Tanner	Lee Jutton
1st V.-Pres....	C. E. Smith	E. B. Ashby	Lee Jutton	F. E. Weise
2nd V.-Pres....	E. B. Ashby	S. C. Tanner	F. E. Weise	W. F. Strouse
3rd V.-Pres....	S. C. Tanner	Lee Jutton	W. F. Strouse	C. R. Knowles
4th V.-Pres....	Lee Jutton	F. E. Weise	C. R. Knowles	A. Ridgway
Sec.-Treas......	C. A. Lichty	C. A. Lichty	C. A. Lichty	C. A. Lichty
Executive Members	F. E. Weise	W. F. Strouse	A. Ridgway	J. S. Robinson
	W. F. Strouse	C. R. Knowles	J. S. Robinson	J. P. Wood
	C. R. Knowles	A. Ridgway	J. P. Wood	A. B. McVay
	A. Ridgway	J. S. Robinson	D. C. Zook	J. H. Johnston
	J. S. Robinson	J. P. Wood	A. B. McVay	E. T. Howson
	J. P. Wood	D. C. Zook	J. H. Johnston	C. W. Wright

	1919-1920	1920-1921	1921-1922	1922-1923
President......	F. E. Weise	W. F. Strouse	C. R. Knowles	Arthur Ridgway
1st V.-Pres....	W. F. Strouse	C. R. Knowles	A. Ridgway	J. P. Wood
2nd V.-Pres....	C. R. Knowles	A. Ridgway	J. S. Robinson	J. S. Robinson
3rd V.-Pres....	A. Ridgway	J. S. Robinson	J. P. Wood	C. W. Wright
4th V.-Pres....	J. S. Robinson	J. P. Wood	C. W. Wright	E. T. Howson
Sec.-Treas......	C. A. Lichty	C. A. Lichty	C. A. Lichty	C. A. Lichty
Asst. Sec......			F. E. Weise	F. E. Weise
Directors	J. P. Wood	C. W. Wright	E. T. Howson	F. C. Baluss
	A. B. McVay	A. B. McVay	J. H. Johnston	Maro Johnson
	J. H. Johnston	G. A. Manthey	E. K. Barrett	O. F. Dalstrom
	E. T. Howson	E. T. Howson	F. C. Baluss	S. D. Corey
	C. W. Wright	J. H. Johnston	Maro Johnson	W. B. Hotson
	G. A. Manthey	E. K. Barrett	O. F. Dalstrom	P. N. Nelson

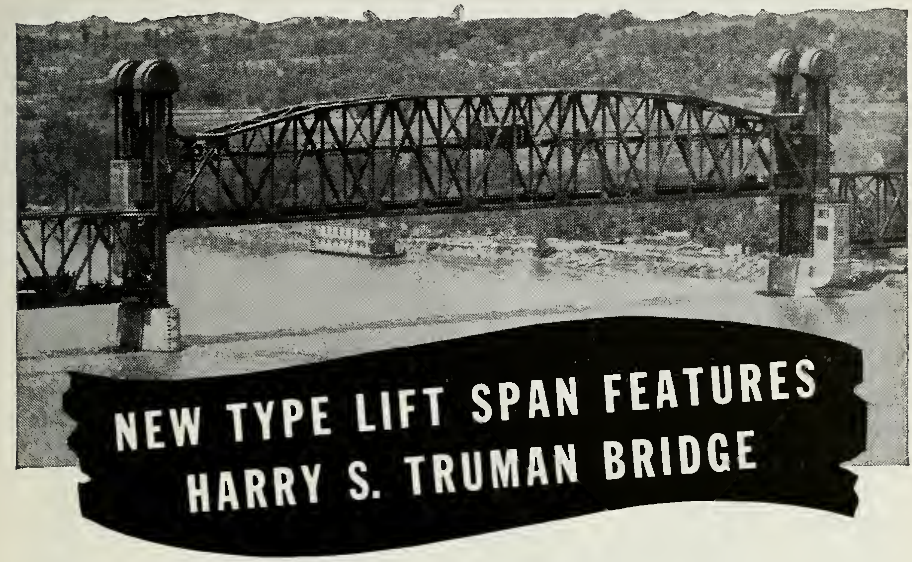
	1923-1924	1924-1925	1925-1926	1926-1927
President......	J. S. Robinson	J. P. Wood	C. W. Wright	E. T. Howson
1st V.-Pres....	J. P. Wood	C. W. Wright	E. T. Howson	F. C. Baluss
2nd V.-Pres....	C. W. Wright	E. T. Howson	F. C. Baluss	Maro Johnson
3rd V.-Pres....	E. T. Howson	F. C. Baluss	Maro Johnson	J. S. Huntoon
4th V.-Pres....	F. C. Baluss	Maro Johnson	J. S. Huntoon	C. S. Heritage
Sec.-Treas.....	C. A. Lichty	C. A. Lichty	C. A. Lichty	C. A. Lichty
Asst. Sec......	F. E. Weise	F. E. Weise	F. E. Weise	F. E. Weise
Directors	S. T. Corey	J. S. Huntoon	C. S. Heritage	A. I. Gauthier
	W. B. Hotson	A. I. Gauthier	W. B. Hotson	E. L. Sinclair
	P. N. Nelson	E. L. Sinclair	P. N. Nelson	O. F. Dalstrom
	J. S. Huntoon	C. S. Heritage	A. I. Gauthier	W. T. Krausch
	A. I. Gauthier	W. B. Hotson	E. L. Sinclair	R. C. Bardwell
	E. L. Sinclair	P. N. Nelson	O. F. Dalstrom	H. I. Benjamin

	1927-1928	1928-1929	1929-1930	1930-1934
President......	F. C. Baluss	Maro Johnson	J. S. Huntoon	C. S. Heritage
1st V.-Pres....	Maro Johnson	J. S. Huntoon	C. S. Heritage	A. I. Gauthier
2nd V.-Pres....	J. S. Huntoon	C. S. Heritage	A. I. Gauthier	H. I. Benjamin
3rd V.-Pres....	C. S. Heritage	A. I. Gauthier	H. I. Benjamin	W. T. Krausch
4th V.-Pres....	A. I. Gauthier	H. I. Benjamin	W. T. Krausch	T. H. Strate
Sec.-Treas.....	C. A. Lichty	C. A. Lichty	C. A. Lichty	C. A. Lichty
Asst. Sec......	F. E. Weise	F. E. Weise		
Directors	W. T. Krausch	R. C. Henderson	G. A. Rodman	E. C. Neville
	R. C. Bardwell	J. S. Ekey	W. A. Batey	H. H. Best
	H. I. Benjamin	T. H. Strate	F. W. Hillman	J. E. King
	R. C. Henderson	G. A. Rodman	E. C. Neville	A. B. Scowden
	T. H. Strate	W. A. Batey	H. H. Best	W. A. Batey
	J. S. Ekey	F. W. Hillman	J. E. King	L. C. Smith

	1934-1935	1935-1936	1936-1937	1937-1938
President......	H. I. Benjamin	T. H. Strate	E. C. Neville	C. M. Burpee
1st V.-Pres....	T. H. Strate	E. C. Neville	C. M. Burpee	F. H. Masters
2nd V.-Pres....	E. C. Neville	C. M. Burpee	F. H. Masters	W. S. Lacher
3rd V.-Pres....	A. B. Scowden	F. H. Masters	C. A J. Richards	C. A. J. Richards
4th V.-Pres....	W. R. Roof	C. A. J. Richards	W. S. Lacher	F. H. Cramer
Sec.-Treas......	C. A. Lichty	C. A. Lichty	C. A. Lichty	C. A. Lichty
Directors	C. M. Burpee	A. L. McCloy	W. R Roof	B. R. Meyers
	W. A. Batey	R. P. Luck	T. P. Soule	G. S. Crites
	L. C. Smith	H. H. Best	F. H. Cramer	R. E. Dove
	C. A. J. Richards	W. R. Roof	B. R. Meyers	T. P. Soule
	A. L. McCloy	T. P. Soule	G. S. Crites	A. Chinn
	R. P. Luck	F. H. Cramer	R. E. Dove	L. G. Byrd

	1938-1939	1939-1940	1940-1941	1941-1942
President......	Armstrong Chinn	A.E.Bechtelheimer	H. M. Church	R. E. Dove
1st V.-Pres....	F. H. Cramer	F. H. Cramer	R. E. Dove	F. H. Soothill
2nd V.-Pres....	A.E.Bechtelheimer	H. M. Church	F. A. Soothill	G. S. Crites
3rd V.-Pres....	H. M. Church	R. E. Dove	G. S. Crites	A. M. Knowles
4th V.-Pres....	R. E. Dove	F. H. Soothill	A. M. Knowles	N. D. Howard
Sec.-Treas.....	C. A. Lichty	C. A. Lichty		
Secretary.....	....	....	F. O. Whiteman	A. G. Shaver
Treasurer.....	....	....	F. E. Weise	F. E. Weise
Directors	L. G. Byrd	B. R. Meyers	N. D. Howard	R. E. Caudle
	W. R. Ganser	W. Walkden	L. G. Byrd	I. A. Moore
	F. H. Soothill	A. S. Krefting	K. L. Miner	W. A. Sweet
	B. R. Meyers	A. M. Knowles	R. E. Caudle	J. L. Varker
	W. Walkden	L. G. Byrd	I. A. Moore	L. E. Peyser
	A. S. Krefting	K. L. Miner	W. A. Sweet	Martin Meyer

THE 1,600-TON, 420-foot long lift span in its raised position provides a channel width of 400 feet and a vertical clearance above low water of 70 feet for navigation. The bridge consists of three 250-ft. through truss spans, one 420-ft. through truss vertical lift span, 18 deck plate girder spans of 78 feet and one plate girder span of 45 feet. It was designed and the construction supervised by Howard, Needles, Tammen & Bergendoff, consulting engineers.



NEW TYPE LIFT SPAN FEATURES HARRY S. TRUMAN BRIDGE

THE HARRY S. TRUMAN BRIDGE crossing the Missouri River at Kansas City, Mo., is the major element of an outstanding railroad relocation project. Undertaken jointly by the Chicago, Milwaukee, St. Paul & Pacific Railroad Company and the Chicago, Rock Island & Pacific Railway Company, it provides a more direct routing of rail traffic through Kansas City, and permits faster-scheduled operations to the West Coast.

This imposing bridge is a single track structure with a total length of 2,633 feet. Its dominating 420-foot vertical lift span over the navigation channel is electrically operated by remote control from a 3-story operating house located on one of the end piers. A gasoline power unit is available for emergency operation.

The unusual features and engineering developments which are embodied in the design and construction of the Harry S. Truman Bridge, contribute to the lasting strength and ruggedness demanded by today's and tomorrow's heavy freight tonnage, great traffic density, and high speed operations. The completed ready-for-traffic superstructure was under contract to American Bridge Company.

Projects such as this point the way to the problems now facing America's railroads—for "better railroading" is here to stay. And as your new plans of roadbed rehabilitation shape up, American Bridge Company will be prepared to meet your every structural need.

AMERICAN BRIDGE COMPANY · USS · STEEL · UNITED STATES STEEL

AMERICAN BRIDGE COMPANY

General Offices: **Frick Building, Pittsburgh, Pa.**

Contracting Offices in: Ambridge · Baltimore · Boston · Chicago · Cincinnati
Cleveland · Denver · Detroit · Duluth · Elmira · Gary · Minneapolis · New York
Philadelphia · Pittsburgh · Portland, Ore. · St. Louis · San Francisco · Trenton
United States Steel Export Company, New York

UNITED STATES STEEL

	1942-1943	1943-1944	1944-1945	1945-1946
President	G. S. Crites	J. L. Varker	J. L. Varker	N. D. Howard
1st V.-Pres.	R. E. Caudle	R. E. Caudle	R. E. Caudle	F. G. Campbell
2nd V.-Pres.	A. M. Knowles	N. D. Howard	N. D. Howard	J. S. Hancock
3rd V.-Pres.	N. D. Howard	F. G. Campbell	F. G. Campbell	E. H. Barnhart
4th V.-Pres.	J. L. Varker	J. S. Hancock	J. S. Hancock	W. F. Martens
Secretary	A. G. Shaver† Lorene Kindred‡ Elinor V. Heffern	Elinor V. Heffern	Elise LaChance	Elise LaChance
Treasurer	F. E. Weise	C. R. Knowles	C. R. Knowles	C. R. Knowles
Treasurer Emeritus		F. E. Weise	F. E. Weise	
Directors	M. Meyer	W. F. Martens	W. F. Martens	A. B. Chapman
	L. E. Peyser	A. L. McCloy	A. L. McCloy	W. A. Huckstep
	K. L. Miner	L. C. Winkelhaus	L. C. Winkelhaus	F. R. Spofford
	F. G. Campbell	E. H. Barnhart	E. H. Barnhart	Guy E. Martin
	J. S. Hancock	A. B. Chapman	A. B. Chapman	B. R. Meyers
	L. C. Winkelhaus	L. E. Peyser	L. E. Peyser	L. E. Peyser

	1946-1947	1947-1948	1948-1949	
President	F. G. Campbell	J. S. Hancock	E. H. Barnhart	
1st V.-Pres.	J. S. Hancock	E. H. Barnhart	W. F. Martens	
2nd V.-Pres.	E. H. Barnhart	W. F. Martins	W. A. Huckstep	
3rd V.-Pres.	W. F. Martens	W. A. Huckstep	Guy E. Martin	
4th V.-Pres.	W. A. Huckstep	G. E. Martin	F. R. Spofford	
Secretary	Elise LaChance	Elise LaChance	Elise LaChance	
Treasurer	C. R. Knowles	C. R. Knowles*	L. C. Winkelhaus	
Directors	Guy E. Martin	H. M. Harlow	Lee Mayfield	
	B. R. Meyers	H B. Christianson	F. M. Misch	
	L. E. Peyser	F. R. Spofford	W. D. Gibson	
	H. M. Harlow	Lee Mayfield	H. M. Harlow	
	H. B. Christianson	Franz M. Misch	V. E. Engman	
	F. R. Spofford	W. D. Gibson	G. W. Benson	

†To November 1, 1942
‡To February 1, 1943

*Died Aug. 6, 1948

TECO CONNECTORS

REDUCE MAINTENANCE COSTS

because--

TECO SPIKED GRIDS have stiffened many trestles and extended their useful life with low maintenance costs.

TECO SPLIT RINGS and SHEAR PLATES have made clear span timber trusses economical for enginehouse and warehouse roofs.

TECO CLAMPING PLATES hold ties tight on open deck bridges while reducing fabrication of ties and guard timbers.

TECO SEGMENTAL WASHERS speed up bolt tightening jobs on timber structures.

For further uses and information see "TECO CONNECTORS FOR TIMBER CONSTRUCTION IN RAILROAD SERVICE." Write for your FREE copy.

TIMBER ENGINEERING COMPANY

Washington, D. C. Chicago New Orleans

CONSTITUTION

ARTICLE I.

NAME

Section 1. This association shall be known as the American Railway Bridge & Building Association.

ARTICLE II.

OBJECT

Section 1.** The object of this association shall be the advancement of knowledge pertaining to the design, construction and maintenance of railway bridges, buildings, water service facilities, and other structures, by investigation, reports and discussions.

Section 2. The association shall neither indorse nor recommend any particular devices, trade marks or materials, nor will it be responsible for any opinions expressed in papers, reports or discussions unless the same have received the endorsement of the association in regular session.

ARTICLE III.

MEMBERSHIP

Section 1. The membership of this association shall be divided into five classes, viz: Members, life members, associate, honorary and junior members.*

Section 2.** A member shall be a person in a position above rank of gang foreman in connection with railway bridge, building and water service work. Any person desirous of becoming a member shall make application upon the form prescribed by the executive committee, setting forth his name, age, residence and practical experience. He shall furnish at least three references to whom he is personally known. Applicants may be voted into membership at any regular executive meeting or by letter ballot of the executive committee, a majority vote being necessary in either instance.

Section 3.** To be eligible for a life membership a member must have belonged to the association for at least twenty years and in general must have retired from active railway service due to age or physical disability. He shall have all the privileges of active membership, except the holding of office, and shall not be required to pay annual dues. The transfer from membership to life membership shall be made in the same manner as the election of members, as prescribed in Section 2, of this Article.

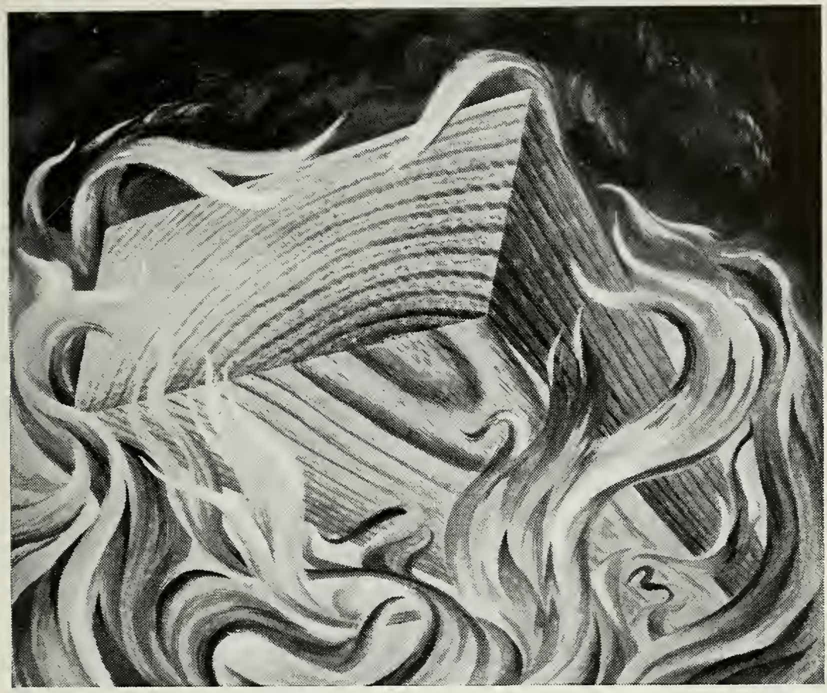
Section 4. Associates shall be responsible persons who are not eligible as members, whose pursuits or attainments qualify them to co-operate with members in the study and development of improved practices in the construction and maintenance of bridges, buildings and water facilities. They shall have all the rights of members except of voting and holding office. They shall be elected in the manner prescribed for members, in Section 2, of this Article.

Section 5. Honorary members shall be chosen from persons who have attained acknowledged eminence in some branch of engineering or railway service. Their number shall be limited to ten. Honorary members shall be proposed by not less than six active members and shall be elected by the unanimous vote of the members present at a regular meeting. They shall have all the rights of active members except that of holding office and shall be exempt from the payment of dues.

---

*Amended October 16, 1941

**Amended September 20, 1948.



NOW . . . Fire-retardant wood for roundhouses!

Looks like ordinary wood, you say? Well, it is wood. But not ordinary! It's a new kind of wood. Koppers has pressure-treated it with certain chemicals.

So what? So ordinary wood becomes amazingly different. It has far greater resistance to decay. It is completely unpalatable to termites. And get this: it is *fire-retardant!*

Yes, wood has joined the fire-safe materials! This Koppers Fire-Retardant Wood greatly reduces all fire hazards . . . has a high degree of resistance to the attacks of fire itself.

Thus, to all the advantages of wood . . . its easy workability, availability, decorative value, economy, re-use value . . . are added resistance to decay and termite attack as well as resistance to fire. Yet the odorless Koppers treatment does not harm the color or paintability of the wood.

This amazing new wood that resists fire is ideally suited for floors, roofing, sheathing, and the structural members of railroad engine houses, bridges, and tunnel linings as well as plants, warehouses, docks and similar structures. For more complete data, send for *Koppers Fire-Retardant Wood,* a new booklet containing interesting, helpful information about this latest development in pressure-treating wood.

KOPPERS COMPANY, INC., Pittsburgh 19, Pa.

KOPPERS **PRESSURE-TREATED WOOD**

Section 6. A junior member shall be a person who is a graduate of a recognized engineering school, or who has been employed for at least two years in the design, maintenance or construction of railway bridges, buildings or structures. Applicants shall be at least 21 years of age and they shall be elected in the manner prescribed for members, in Section 2 of this article. Juniors shall have all the rights of members except that of holding office. When the attainments of a Junior are such as to qualify him as a member, he may apply for promotion and the Executive Committee shall authorize such promotion when qualifications warrant the action. Unless a Junior is promoted, his membership shall cease automatically when he becomes 28 years of age.*

Section 7. Any member guilty of conduct unbecoming a railroad officer and a member of this association, or who shall refuse to comply with the rules of this association, shall forfeit his membership on a two-thirds vote of the executive committee.

Section 8. Membership shall continue until written resignation is received by the secretary, unless member has been previously expelled, or dropped for non-payment of dues in accordance with Section 1 of Article VII.

Section 9.** Only active members shall hold office in this association, and only active and life members shall be entitled to vote in the election of officers.

ARTICLE IV.

OFFICERS

Section 1. The officers of this association shall be a president, four vice-presidents, a secretary, a treasurer and six directors who with the most recent past president shall constitute the executive committee.

Section 2. The past presidents of this association, previous to the most recent past president, who continue to be members, shall be privileged to attend all meetings of the executive committee, of which meetings they shall receive due notice, and be permitted to discuss all questions and to aid said committee by their advice and counsel; but said past presidents shall not have a right to vote, unless called upon to fill a quorum.

Section 3. Vacancies in any office shall be filled for the unexpired term by the executive committee without delay.

ARTICLE V.

EXECUTIVE COMMITTEE

Section 1.** The executive committee shall manage the affairs of the association and shall have full power to control and regulate all matters not otherwise provided for in the constitution and by-laws and shall exercise general supervision over the financial interests of the association, and make all necessary purchases and contracts required to conduct the general business of the association but shall not have the power to render the association liable for any debt beyond the amount then in the treasury plus accounts rceivable and not subject to other prior liabilities. All appropriations for special purposes must be acted upon at a regular meeting of the association.

Section 2. Meetings of the executive committee may be called by a majority of the members of the committee, providing 10 days' notice is given members by mail.

Section 3. Five members of the executive committee shall constitute a quorum for the transaction of business.

ARTICLE VI.

ELECTION OF OFFICERS AND TENURE OF OFFICE

Section 1. Except as otherwise provided the officers shall be elected at the regular annual meeting of the association and the election shall not be postponed except by unanimous consent of the members present at said annual meeting. The election shall be by ballot, a majority of the votes cast being required for election. Any active member of the association not in arrears for dues shall be eligible for office, but the president shall not be eligible for reëlection.

---

*Amended October 16, 1941.

**Amended September 20, 1948.

CLEAN TREATED LUMBER
for bridges and buildings,
platforms, roofs and decks

●

Where a clean, odorless, paintable treated lumber is required, specify "Wolmanized" brand. Treatment with "Wolman" wood preservative salts introduces no fire hazard. Service records over 25 years prove its effectiveness in protecting against decay and termites.

●

AMERICAN LUMBER & TREATING CO.
332 SOUTH MICHIGAN AVENUE • CHICAGO

Wolmanized VACUUM-PRESSURE TREATED **LUMBER**

Section 2.† The president, four vice-presidents, secretary and treasurer shall hold office for one year and the directors for two years, three directors being elected each year. All officers retain their offices until their successors are elected and installed.

Section 3.† The term of office of the secretary and the treasurer may be terminated at any time by a two-thirds vote of the executive committee. Their compensation shall be fixed by a majority vote of the executive committee.

The secretary shall also serve as secretary of the executive committee.

Section 4. The secretary and the treasurer shall be required to give bond in an amount to be fixed by the executive committee.

ARTICLE VII.

MEMBERSHIP FEE AND DUES

Section 1.† Every member upon joining this association shall pay to the secretary an entrance fee and dues as prescribed by the executive committee. No member in arrears for annual dues shall be entitled to vote at any election and any member more than one year in arrears may be stricken from the list of members at the discretion of the executive committee.

ARTICLE VIII.*

LOCAL SECTIONS

Section 1.** Upon the application of ten or more members of the association residing in the same geographical district, or having offices therein, the executive committee shall organize a local section for that district, to which all members in that district shall be eligible. Such local section shall admit to active membership only members in good standing. It shall hold not less than two meetings each year, and shall be governed by such constitution and by-laws not inconsistent with the constitution of this association as the section membership may adopt and the executive committee of the association approve.

Section 2. The parent association shall not be put under any obligation, either financial or in the matter of policy or opinion, by any local section.

ARTICLE IX.

AMENDMENTS

Section 1. This constitution may be amended at any regular meeting by a two-thirds vote of the members present, provided that notice of the proposed amendment or amendments has been sent to the members at least 30 days previous to said regular meeting.

BY-LAWS

TIME OF MEETING

1.** The regular meeting of this association shall convene annually during the month of September, the exact date to be fixed by the Executive Committee.

PLACE OF MEETING

2.** The place of holding the annual convention shall be Chicago, Ill.

3. It shall lie within the power of the executive committee to change the location or time of the meeting if it becomes apparent that it is for the best interests of the association.

QUORUM

4. At the regular meeting of the association, 15 or more members shall constitute a quorum.

---

†Amended October 17, 1940.

*Article adopted 1922.

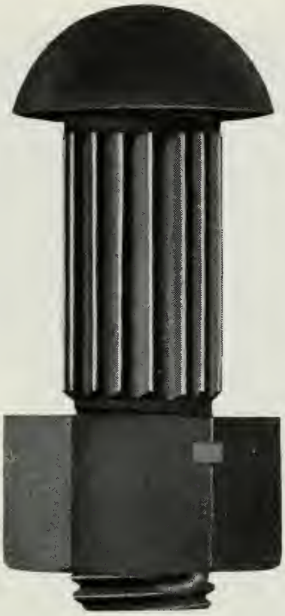
**Amended September 20, 1948.

STRUCTURAL RIB BOLTS

Better than rivets

• • • for bridges and trestles

• • • for general steel construction



STRUCTURAL RIB BOLTS offer many advantages over rivets for steel work. When driven into a hole in the work with an ordinary hammer, the triangular ribs deform to make a body-bound fit and lock bolt in position. Only two men with a hammer and wrench are needed to apply; riveting requires three or four men with riveting forge, compressor, and riveting hammer. Fast, stronger, dependable, they assure lower construction costs. Use them with ANCO nuts for permanency.

STRUCTURAL RIB BOLTS, equipped with Anco Lock Nuts, have been approved in place of field-driven rivets for many types of steel erection since 1937, in practically every state and in several foreign countries. They have been approved by the U. S. Treasury Department, Division of Architecture, City Building Code Authorities, and State Highway Department based on the results of many tests, including those of Robert W. Hunt Company and and the University of Wisconsin.

The STRUCTURAL RIB BOLT has

• • • A HIGHER TENSILE VALUE than rivets. It is made from carbon manganese steel, galvanized or black, with a minimum tensile strength of 70,000 lb. per sq. in. as compared to 52,000 to 62,000 lb. per sq. in. for rivets.

• • • A HIGH ALLOWABLE SHEAR VALUE of 22,465 lb. per sq. in.

• • • A HIGH BEARING, S.S. VALUE of 32,000 lb. per sq. in.

• • • A HIGH BEARING, D.S. VALUE of 40,000 lb. per sq. in.

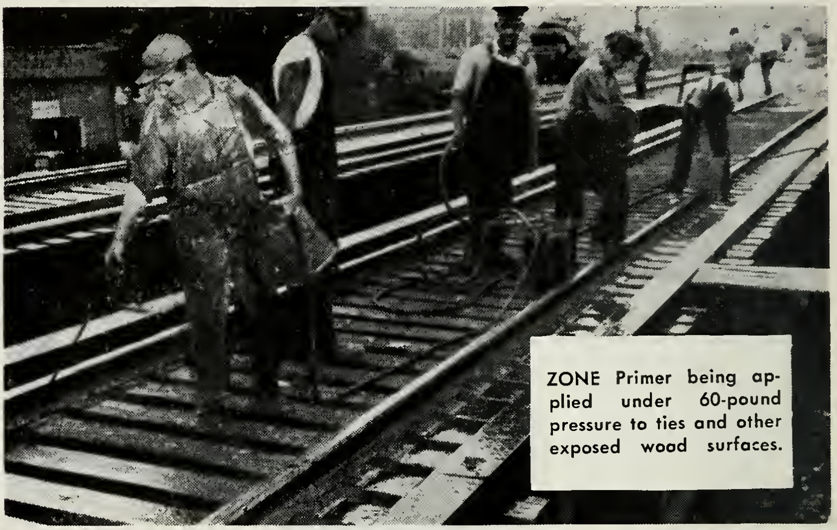
With such values in strength, a fewer number of these bolts than rivets is required for making the same connection. Ideal for bridges, coaling and water stations, sand towers, Diesel shop buildings, and all other steel-framed railroad structures. Why not get complete information and testing samples of the Structural Rib Bolts and Anco Lock Nuts? A word from you on your letterhead does it.

AUTOMATIC NUT COMPANY

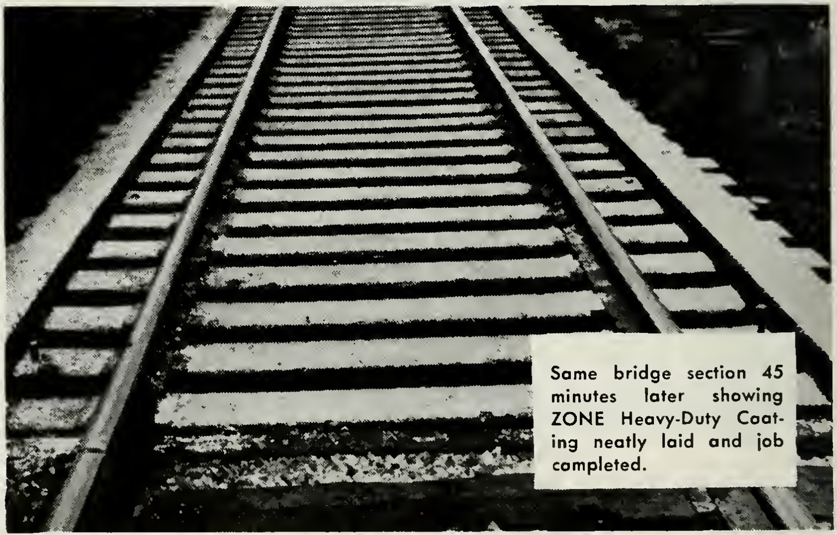
LEBANON, PENNSYLVANIA
Warehouse — Chicago, Illinois

For inquiries and samples write to
R. J. Voss, District Manager, 310 S. Michigan Ave., Chicago 4, Ill.

Prevent Bridge Fire Expense and Hazard . . .



ZONE Primer being applied under 60-pound pressure to ties and other exposed wood surfaces.



Same bridge section 45 minutes later showing ZONE Heavy-Duty Coating neatly laid and job completed.

adopt the proved

LIBBEY-ZONE

PROCESS

Brake shoe sparks, lighted cigarettes tossed by careless smokers, molten metal from overheated shoes, and from oil, coal and other fuel from locomotive boxes...all find a fire hungry target in unprotected wood surfaces where ordinary coatings have worn down or cracked open.

Leading railroads (names on request) are now restricting fires with the LIBBEY-ZONE Process using ZONE Heavy-Duty Coating...the scientific discovery that combines Canadian asbestos fibre with intensified asphalt gum to produce a long-lasting, economical, genuinely fire retardant surface for open-deck bridges and trestles.

ZONE Heavy-Duty Coating, when combined with the proper aggregate of crushed stone or gravel, expands with heat...yet does not melt; contracts with cold...yet does not flake. This protective coating is easily and quickly applied. Nationally distributed. Ask for our free booklet... and learn the advantages of

ZONE

HEAVY-DUTY COATING

The Zone Company

Div. of Southwestern Petroleum Co., Inc., Fort Worth 1, Tex.

ZONE *HEAVY-DUTY COATING...for fire retardant protection.*

**DUES

5. The annual dues, for the fiscal year ending August 31, and payable in advance, shall be as follows:*

Members, $5.00; Associate Members, $4.00; Junior Members, $2.50.

DUTIES OF OFFICERS

6.† The president shall have general supervision over the affairs of the association. He shall preside at all meetings of the association and of the executive committee; shall appoint all committees not otherwise provided for, and shall be ex-officio member of all committees. He shall with the secretary sign all contracts or other written obligations of the association which have been approved by the executive committee. He shall render a detailed report at least three times during the year to the members of the executive committee, showing the financial condition of the association and its activities.

At the annual meeting the president shall present a report containing a statement of the general conditions of the association.

7. The vice-presidents in order of seniority shall preside at meetings in the absence of the president and discharge his duties in case of a vacancy in his office.

8.† It shall be the duty of the secretary to keep a correct record of the proceedings of all meetings of this association, and of all accounts between this association and its members; to collect all moneys due the association, and deposit the same in the name of the association. He shall pay all bills when properly certified and approved by the president and the treasurer, and make such reports as may be called for by the executive committee. He shall also perform such other duties as the association may require.

9.‡ The treasurer shall have charge of the funds, check all deposits as made by the secretary, sign all checks after they have been approved by the president, and invest all funds not needed for current expenses as directed by the executive committee. He shall report at each annual meeting on the condition of the finances.

NOMINATING COMMITTEE

10. After each annual meeting the president shall appoint a committee of five members, not officers of the association, of whom two at least shall be past presidents, and two of whom shall have served on the committee the previous year, which shall prepare a list of names of nominees for officers to be voted on at the next annual convention, in accordance with Article VI of the constitution, said list to be read at the first session of the second day of said convention. Nothing in this section shall be construed to prevent any member making further nominations.

AUDITING COMMITTEE

11.‡ Prior to each annual meeting the president shall appoint a committee of three members, not officers of the association, whose duty it shall be to examine the accounts and vouchers of the secretary and the treasurer and certify as to the correctness of their accounts.

COMMITTEE ON SUBJECTS FOR DISCUSSION

12. After each annual meeting the president shall appoint a committee whose duty it shall be to prepare a list of subjects for investigation to be submitted for approval at the next convention.

COMMITTEE ON INVESTIGATION

13. After the association has adopted the list of subjects for investigation the president for the succeeding year shall appoint the committees who shall prepare the subjects for report and discussion. He may also appoint individual members to prepare reports on special subjects, or to report on any special or particular subject.

---

*Amended October 16, 1941.

†Amended October 17, 1940.

‡Adopted October 17, 1940

**Amended September 20, 1948.

51 Year Old Bridge Ties Still Good Because They Are DRY on This Covered Railroad Bridge

BIRD TIE PADS DO THE SAME FOR THE UNDER PLATE AREA

The original ties installed in 1898 are 51 years old and still like new. They appear to be good for another 50 years or more.

Come to our booth at the Colosseum in September to examine actual ties from this bridge and to see how the sealing feature of Bird Tie Pads provides equally effective under plate protection.

BIRD TIE PADS

BIRD
& SON, inc.
Established 1795

Bird & Son, inc.
EAST WALPOLE, MASS.

PUBLICATION COMMITTEE

14. After each annual meeting the executive committee shall appoint a publication committee consisting of three active members whose duty it shall be to coöperate with the secretary in the issuing of the publications of the association. The assignment of this committee shall be such that at least one member shall have served on the committee during the previous year.

ORDER OF BUSINESS

15.† Call to order by president.
Opening prayer or invocation.
President's address.
Report of secretary.
Report of treasurer.
Appointment of special committees.
Reports of standing committees and presentation of papers.
Unfinished business.
New business.
Election of officers.
Installation of officers.
Adjournment.

DECISIONS

16. The votes of a majority of the members present shall decide any questions, motion or resolution which shall be brought before the association, unless otherwise provided. Unless specifically provided herein otherwise all discussions shall be governed by Robert's rules of order.

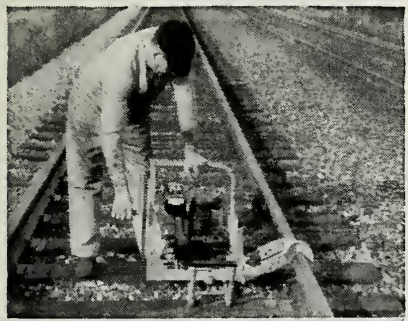
AMENDMENTS

17.† The By-Laws can be amended by a two-thirds vote of those present at any regularly called Executive Committee Meeting.

---

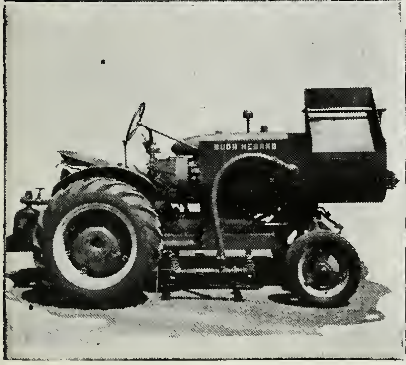
†Amended September 20, 1948

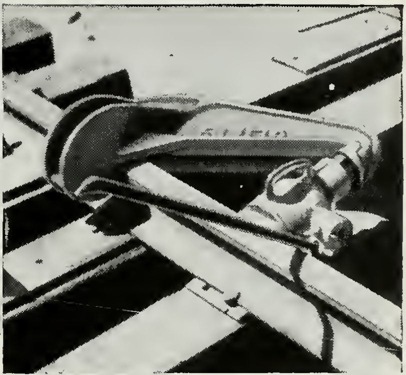
BUDA *serving the railroads since 1881*



• ***LEFT:*** **BUDA Power Track Drill for drilling bolt holes in "T" rail, girder rail or "I" beams, quickly and accurately. Light weight—powerful engine.**

• ***BELOW:*** **BUDA Rail Bender, bends heavy cold rail. One man bends 151 lb. rail easily with this handy tool.**





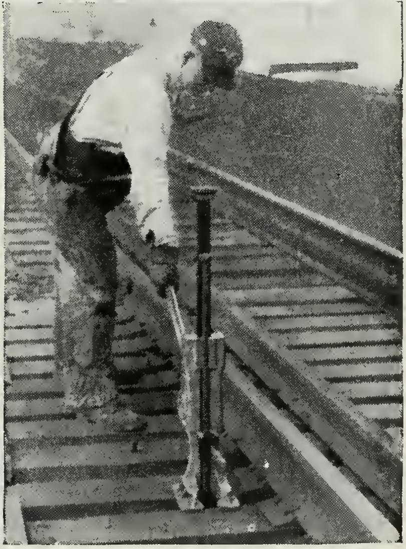
•***ABOVE:*** **We will be glad to discuss the application of the new Buda-Hebard Grouter to your roadbed stabilization problems.**

• ***RIGHT:*** **BUDA Klinch-Klaw Jack, ideal for pulling bolts and spikes from bridges and trestles.**

WRITE FOR LITERATURE

BUDA

HARVEY *(Chicago Suburb)* ILLINOIS



DIRECTORY OF MEMBERS

as of March 1, 1950

(Figure after each name indicates year when member joined association.)

ACTIVE MEMBERS

H. C. Aaron, Supv. B. & B., W. M. R. R., Hagerstown, Md., (1935).
A. F. Ainslie, Supv. B. & B., N. P. Ry., Spokane, Wash., (1948).
H. J. Aliberti, Asst. Supv. B. & B., Me. C. Ry., Portland, Me., (1947)
G. A. Allen, Br. Insp., C. & O. Ry., Clifton Forge, Va., (1940).
J. L. Alvord., Div. Engr., C. & O. Ry., Saginaw, Mich., (1950)
A. Anderson, Sp. Asst. Engr., N. Y. C. R. R., Chicago, (1947)
J. L. Anderson, Sup. B. & B., Mo. Pac. R. R., Osawatomie, Kans., (1931).
J. T. Andrews, Spec. Engr., B. & O. R. R., Baltimore, Md., (1947)
W. F. Armstrong, Arch. Dftsmn., C. & N. W. Ry., Chicago, (1947)
T. J. Atkinson, Mast. Carp., Penn. R. R., Pittsburgh, Pa., (1947)
S. K. Autrey, B. & B. & W. S. Insp., Burlington-Rock Island, Teague, Tex.

J. H. Babbitt, Asst. Div. Eng., B. & O. R. R., Indianapolis, Ind., (1946).
R. C. Baker, B. & B. Supv. C & E. I. Ry., Danville, Ill., (1940)
E. H. Barnhart, Div. Engr., B. & O. R. R., Garrett, Ind., (1941).
H. L. Barr, Div. Engr., C & N. W. Ry., Boone, Ia., (1938)
G. J. Bass, Gen. For., B. B. & W. S., G. C. & S. F. Ry., Galveston, Tex., (1946).
Y. C. Beam, Asst. Mast. Carp., S. A. L. Ry., Americus, Ga., (1945).
A. E. Bechtelheimer, (Retired) Engr. of Br., C. & N. W. Ry., Winnetka, Ill., (1920).
W. H. Begeman, B. & B. Supvr., Mo. Pac. R. R., Jefferson City, Mo., (1941).
J. G. Begley, Div. Engr., B. & O. R. R., Washington, Ind., (1946).
H. I. Benjamin, Vice-Chair. Sys., Com. on Ins., So. Pac. Ry., San Francisco, Cal., (1922).
L. E. Benner, Asst. B. & B., N. Y. C., Detroit, Mich., (1949).
G. W. Benson, Supt. Bridges, C. of G. Ry., Macon, Ga., (1940).
J. A. Bergeron, Asst. B. & B. Master, C. N. R., Parent, Que., (1949).
M. A. Beringer, Br. Insp., I. C. R. R., Chicago, (1929).
C. E. Bingaman, Mast. Carp., Reading Co., Tamaqua, Pa., (1948).
H. F. Bird, Supv. B. & B., N. Y. C. Sys., Syracuse, N. Y., (1937).
R. D. Bisbee, Div. Engr., P. & S. F. Ry., (A. T. & S. F.) Slaton, Tex., (1947).
A. E. Blaes, Term. B. & B. For., St. L.-S. F., Springfield, Mo., (1950).
O. H. Blankenship, W. S. For., M. P. R. R., Poplar Bluff, Mo., (1948).
E. H. Blewer, Supv. Saf. Engr., N. Y. C. Sys., New York, (1937).
M. Block, Engr. of Bridges, I. C. R. R., Chicago, (1948).
H. Bober, B. & B. Engr., G. M. & O. R. R., Mobile, Ala., (1947).
H. A. Boehling, Jr., Asst. Cost Engr., C. & O. Ry., Richmond, Va., (1948).
W. C. Borchert, Div. Engr., K. C. S., Shreveport, La., (1942).
M. A. Bost, Asst. Engr., C. M. St. P. & P. R. R., Mason City, Iowa, (1935).
J. J. Brandimarte, Jr., Asst. Mast. Carp., Penn. R. R., Harrisburg, Pa., (1947).
B. H. Brandt, Mast. Carp., C. B. & Q. R. R., Galesburg, Ill., (1946).
I. C. Brewer, Div. Engr., C. M. St. P. & P. R. R., Milwaukee, Wis., (1947)
W. T. Brice, B. & B. Master, C. N. R., Regina, Sask., Can., (1946).
E. J. Brown, Engr. of Track, C. B. & Q. R. R., Chicago, (1947)
T. W. Brown, Chf. Water Chem., I. C. R. R., Chicago (1947)
W. O. Bruce, Spl. Repr. to Vice-Pres. (Oper.), C. R. I. & P. R. R., Chicago, (1948).
C. O. Bryant, Div. Engr., C. R. I. & P., Kansas City, Mo., (1950).
F. N. Budzenski, Asst. Supv. B. & B., C. & N. W. Ry., Antigo, Wis., (1938).
W. H. Bunge, Asst. Engr., M. P. Lines, Houston, Tex., (1941).
E. E. Burch, Asst. Br. Engr., C. M. St. P. & P. Ry., Chicago (1945)
A. E. Burford, Gen. For. B. & B., I. C. R. R., Memphis, Tenn., (1947)
W. R. Burke, B. & B. Supv., I. C. R. R., Champaign, Ill., (1947)
A. L. Burleson, B. & B. Insp. (St. L.-S. F. Ry., Memphis, Tenn., (1947)
C. M. Burpee, V.-P. Sls. Pro., Simmons-Boardman Pub. Corp., New York, (1930).
C. D. Burrows, Mast. Carp., B. & O. R. R., Wilmington, Del., (1946).

W. W. Caines, Asst. Supv. B. & B., C. & O. Ry., Huntington, W. Va., (1938).
F. G. Campbell, Ch. Engr., E. J. & E. Ry., Joliet, Ill., (1936).
J. G. Carlon, Asst. Supv. B. & B., C. & O. Ry., Russell, Ky., (1947)
M. D. Carothers, Ch. Engr., G. M. & O. R. R., Bloomington, Ill., (1938).
R. B. Carruthers, Br. Engr., T. & N. O. Ry., (S. P. Lines), Houston, Tex., (1946)
J. W. Carter, B. & B Supv., Vir. Ry. Co., Roanoke, Va., (1947)
R. W. Cassidy, Asst. Supv., B. & B., C. & O. Ry., Richmond, Va., (1949).
R. E. Caudle, Asst. Engr. Str., M. P. Lines, Houston, Tex., (1921).

LONG LASTING *Protection...*

with GEDCO RESTORATION SERVICE

PAYS DIVIDENDS

BEFORE AND AFTER

GEDCO'S modern methods of restoration eliminate costly, periodic repainting of masonry buildings and restores the original appearances. Railroad companies are especially pleased with GEDCO restoration and refinishing methods. The photographs (above) show the "before and after" of a building from which paint was removed and the brick work tuck-pointed, then waterproofed. Result—improved appearances and long lasting protection.

If you have buildings that need a face lifting or restoration of masonry give us a call. We have the equipment and the experience to handle any restoration job, anywhere.

Consult Gedco

for the following service . . .

- GUNITE
- PRESSURE GROUTING
- PUMPCRETE
- WATERPROOFING
- CONCRETE RESTORATION
- RESTORATION OF CONCRETE AND ALL MASONRY SURFACES

GEORGE E. DETZEL COMPANY

Pressure Grouting and Gunite Service

2303 GILBERT AVE. CINCINNATI 6, OHIO

T. M. Cawthon, Asst. B. & B. Supv., S. P. Co., Martinez, Calif., (1943).
P. C. Chamberlain, Asst. Engr., Erie R. R., Cleveland, Ohio, (1941)
A. B. Chaney, Asst. Chief Engr. M. W., Mo. Pac. Lines, St. Louis, Mo., (1947).
S. L. Chapin, Saf. Supv., So. Pac. Co., San Francisco, Calif., (1946).
A. B. Chapman, Asst. Chief Engr., C. M. St. P. & P. R. R., Chicago, (1938).
A. Chinn, Pres., Term. R. R. Assoc. of St. L., St. Louis, Mo., (1930).
H. B. Christianson, Prin. Asst. Engr., C. M. St. P. & P. Ry., Chicago, (1928).
C. M. Chumley, Engr. M. of W., I. C. R. R., Chicago, (1947)
M. A. Clancy, Gen. Steel Fore., D. & H. R. R., Green Island, N. Y., (1942).
L. Clapper, Ch. Engr., D. M. & I. R. Ry., Duluth, Minn., (1919).
K. L. Clark, Div. Engr., C. M. St. P. & P. R. R., Chicago (1939)
W. P. Clark, Supv. B. & B., L. V. R. R., Wilkes-Barre, Pa., (1944).
E. J. Clopton, Div. Engr., B. & O. R. R., Cumberland, Md. (1944).
G. W. Cobb, Asst. B. & B. Supv., So Pac. Co., Sparks, Nev. (1948).
G. Cole, B. & B. Gen. For., A. T. & S. F. Ry., Emporia, Kan., (1949).
E. L. Collette, Sr., Div. Engr., St. L.-S. F., Fort Smith, Ark., (1949).
P. B. Collier, Supt. Scales, M. P. R. R., St. Louis, Mo., (1938).
R. L. Collum, Mast. Carp., S. A. L. Ry., Jacksonville, Fla., (1941).
A. A. Colvin, Div. Engr., C. & N. W. Ry., Norfolk, Nebr., (1937).
D. W. Converse, Br. Engr., A. C. & Y. R. R., Akron, Ohio, (1940).
E. F. Cook, Water Serv. For., Mo. Pac. R. R., Little Rock, Ark., (1947)
B. Cooper, Br. Inspr. Mo. Pac. R. R.,DeQuincy, La., (1947)
A. E. Copeland, Mast. Carp., C. B. & Q. R. R., North LaCrosse, Wis., (1947)
R. F. Copeland, Mast. Carp., C. B. & Q. R. R., Creston, Iowa, (1950).
F. J. Corporon, Supt. W. & S., C. S. S. & S. B., Michigan City, Ind., (1950).
L. A. Cowsert, W. Insp., B. & O. R. R., Dayton, Ohio, (1915).
R. P. Cox, Engr. of Power Plant, C. B. & Q. R. R., Chicago, (1947)
F. H. Cramer, Br. Engr., C. B. & Q. R. R., Chicago, (1927).
F. W. Creedle, Asst. Engr. of Mtce., C. & N. W. Ry., Chicago, (1942).
C. H. Crews, B. & B. Supv., I. C. R. R., Jackson, Tenn., (1947)
P. H. Croft, Div Engr. I. C. R. R., Chicago, (1947)
M. Cronin, Asst. B. & B. Supv. So. Pac. Co., Tucson, Ariz., (1943)
W. E. Crounse, Supv. B. & B., D. & H. R. R., Carbondale, Pa., (1945).
J. W. Cummings, Supv. Wk. Eqpt., D. & H. R. R., Albany, N. Y., (1947)
C. P. Cummins, Asst. Engr., M. K. T. R. R., St. Louis, Mo., (1948).
H. D. Curie, Mast. Carp., B. & O. R. R., Garrett, Ind., (1942).

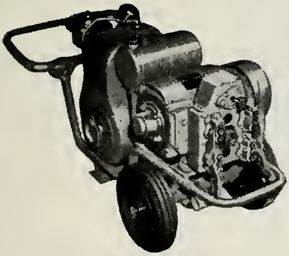
P. E. Dale, Supv. B. & B., N. Y. C. Sys., Indianapolis, Ind., 1947)
G. B. Davis, B. & B. Supv., N. Y. C. Sys., Columbus, Ohio. (1942)
H. E. Davis, B. & B. Supv., N. Y. C., Sys. Chicago, (1940).
L. H. Davis, Gen. For. B. & B., A. T. & S. F. R. R., Amarillo, Tex., (1948).
F. D. Day, Mast. Carp., Penn. R. R., Pittsburgh, Pa., (1949).
R. DeArmond, Asst. B. & B. Supv., So. Pac. Co., San Francisco, Cal., (1938).
H. R. Demmon, Asst. Gen. B. & B. Insp., So. Pac. Co., Albany, Calif., (1948).
A. H. Deno, Supv., B. & B., C. & N. W. Ry., Green Bay, Wis., (1941).
L. J. Deno, Office Engr., C. & N. W. Ry., Chicago, (1947).
A. R. De Walt, Mast. Carp., Penn. R. R., Cleveland, O., (1949).
H. M. Dick, Mast. Carp., Penn. R. R., Harrisburg, Pa., (1942).
M. H. Dick, Ed., Ry. Engr. & Mtce., Chicago, (1937).
N. Dixon, B. & B. Mast., C. N. R., Montreal, Que., (1949).
Fred Dodson, Asst. Supv. B. & B., C. & O. R. R., Covington, Ky., (1948).
A. G. Dorland, Asst. Engr., E. J. & E. Ry., Joliet, Ill., (1941).
J. L. Dougherty, Supv. B. & B., W. M. Ry., Cumberland, Md., (1944).
R. E. Dove, Man. Ed., Ry. Engr. & Mtce. Cycl., Chicago, (1934).
C. R. DuBose, Res. Engr., Mo. Pac. R. R., Houston, Tex., (1948).
J. V. Duchac, Supv. B. & B., C. & N. W. Ry., Antigo, Wis., (1927).
J. P. Dunnagan, Engr. of Br., So. Pac. Co., San Francisco, Calif., (1943).
F. Duresky, Jr., Supv. B. & B., C. & N. W. Ry., Huron, So. Dak., (1942).
W. E. Dwy, Field Engr., B. & O. R. R., Pittsburgh, Pa., (1948).

J. Ebbens, Supv. B. & B., C. & W. I. R. R., Chicago, (1947).
C. M. Eichenlaub, Res. Engr., S. D. & A. E. Ry. Co., San Diego, Cal., (1943).
C. Eisele, Asst. Engr., N. Y. C. Sys., Chicago, (1930).
C. E. Elliott, Div. Engr., W. P. R. R., Sacramento, Cal., (1950).
L. Elower, Traveling Br. Insp., Erie R. R., Owego, N. Y., (1948).
E. M. Enger, Supr. B. & B., C. St. P. M. & O. Ry., St. Paul, Minn. (1947).
N. V. Engman, Assoc. Edtr., Ry. Engr. & Mtce., Chicago, (1949).
V. E. Engman, Ch. Carp., C. M. St. P. & P. R. R., Savanna, Ill., (1920).
J. M. Erickson, B. & B. Supv., Wab. R. R., Montpelier, Ohio, (1950).
F. A. Ernst, Div. Engr. B. & O. R. R., Pittsburgh, Pa., (1948).
H. E. Ezzell, Asst. Scale Supv. Mo. Pac. Lines, San Antonio, Tex., (1947)

C. U. Faircloth, Br. Inspr., I.-G. N. R. R. (Mo. Pac.), Palestine, Tex., (1947).
C. Fest, Asst. B. & B. Supv., So. Pac. Co., Milwaukie, Ore., (1948).

for THE RELIABILITY and PRODUCTIVITY B & B OPERATIONS REQUIRE!

●



Model M-2 Portable Power Plant 2.5 KVA capacity, is shown above. Other models 1.25 and 5 KVA capacities are also available.

JACKSON PORTABLE POWER PLANTS

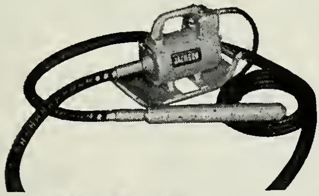
With Permanent-Magnet Generators

Generators require no maintenance, no adjustment; are absolutely trouble-proof and produce BOTH single-phase and 3-phase 60 cycle 110 volt AC to full rated capacity. Powered by husky Wisconsin gas engines. Proved outstandingly reliable throughout the railway and construction fields. Ideal for operating vibrators, power tools and lights and will give continuous, uninterrupted service day in and day out.

JACKSON HYDRAULIC CONCRETE VIBRATOR

With 50 ft. Reach. Makes the hard-to-get-at places easy to reach. Saves time by making frequent relocations of machine unnecessary. Provides frequencies from idling to 7200 VPM. 2¾" x 21" vibrator head. All moving parts run in oil. Husky 7 HP Engine.

JACKSON FLEXIBLE SHAFT ELECTRIC VIBRATOR



2½ HP Motor. Plenty of power to handle the stiffest mixes with maximum length of shaft (28'.) Operates from light socket or Jackson Power Plant. Available with 3 vibrator heads and any length of shafting up to 28', attachments for wet or dry rubbing. Weighs only 50 lbs.

JACKSON PAVING UNIT Consists of a manually guided vibratory screed powered by Jackson portable power plant. Perfect for paving, patching, bridge decks, etc. Undercuts at side forms — works right around manholes and other obstructions — strikes off crowns, regular or inverted.

JACKSON SOIL COMPACTOR Quickly and easily provides maximum density in bridge approaches and similar fills. Propels itself. Firmly compacts 10 to 15 sq. ft. per minute of granular soil to a depth of 12 inches. Produces 95% maximum density in a single pass.

WRITE FOR free copy of the Jackson "POCKET GUIDE" describing the complete line.

ELECTRIC TAMPER & EQUIPMENT CO.
LUDINGTON MICHIGAN

L. M. Firehammer, Gen. Supv. B. & B., Ill. Term. R. R., Springfield, Ill., (1919).
G. R. Fisher, B. & B. Master, Ca. Nat. R. R., Stratford, Ont., Canada, (1948).
E. E. Foster, Asst. Engr., M. St. P. & S. S. M. R. R., Stevens Point, Wis., (1947)
K. Fouts, Gen. For. B. & B. & W. S., St. L. S. F. R. R., Chaffee, Mo., (1948).
R. L. Fox, Div. Engr., So Ry., Alexandria, Va., (1935)
C. G. Friets, Supv. B. & B., C. & N. W. Ry., Escanaba, Mich., (1938).
H. C. Fronabarger, B. & B. Supv., T. & P. Ry., Fort Worth, Tex., (1949).
L. M. Frost, Supv. B. & B., G. T. W. Ry., Battle Creek, Mich., (1938).
W. E. Fuhr, Div. Engr., C. M. St. P. & P. R. R., Miles City, Mont., (1948).
B. J. Furniss, B. & B. Supv., N. Y., N. H. & H. R. R., Hartford, Conn., (1946).

C. W. Gabrio, Br. Engr., Virginian Ry., Norfolk, Va., (1947)
J. Galbraith, B. & B. Supv., N. Y. C. R. R., New York, N. Y., (1947)
F. E. Galvin, Chief Carp., C. M. St. P. & P. R. R., La Crosse, Wis., (1948).
J. P. Gannon, Div. Engr., M. St. P. & S. S. M. Ry., Stevens Point, Wis., (1947).
J. W. Gannon, Jr., Supv. B. & B., B. & M. R. R., Concord, N. H., (1948).
W. R. Ganser, Mast. Carp. Penn. R. R., Jersey City, N. J., (1931)
C. E. Garcelon, Supt. B. & B., B. & A. R. R., Houlton, Me., (1945).
L. D. Garis, Gen. Br. Inspr., C. & N. W. Ry., Chicago, (1930).
C. J. Geyer, Asst. Vice-Pres., C. & O. Ry., Richmond, Va., (1928).
W. D. Gibson, W. S. Engr., C. B. & Q. R. R., Chicago, (1946).
C. F. Gilbert, B. & B. Supv., C. & O. Ry., Peru, Ind., (1944).
J. M. Giles, Asst. Engr. Rdway Machines, M. P. R. R., St. Louis, Mo., (1938).
W. G. Gillespie, Mast. Carp., B. & O. R. R., Grafton, W. Va., (1946).
R. W. Gilmore, Gen. Br. Insp., B. & O. R. R., Cincinnati, Ohio, (1943).
A. M. Glander, Ch. Carp., C. M. St. P. & P. Ry., Mason City, Iowa, (1936).
E. U. Gogl, Prin. Asst. B. & B. Supv., So Pac. Co., Hillsboro, Ore., (1948).
J. L. Gorrie, Asst. B. & B. Supv., So. Pac. Co., Eugene, Ore., (1948).
H. E. Graham, Asst. Supt. W. S.. I. C. R. R.. Chicago, (1946).
W. R. Graham, Asst. Supv. B. & B., C. & O. R. R., Erlanger, Ky., (1946).
H. P. Greene, Mast. Carp. Penn. R. R., Columbus, Ohio, (1947).
A. Guenther, Asst. Mast. Carp., C. B. & Q. R. R., Galesburg, Ill., (1947)
R. R. Gunderson, Asst. Br. Engr., So. Ry. Co., Washington, D. C., (1947).
J. M. Gustafson, Br. Engr., Minn. & St. Louis Ry., Minneapolis, Minn., (1948).

E. H. Haase, B. & B. Supv., So. Pac. Co., La Fayette, Cal., (1943).
C. A. Hackett, Asst. B. & B. Supv., So. Pac. Co., El Paso, Tex., (1948).
S. H. Hailey, Sr. Asst. Engr., N. C. & St. L. Ry., Nashville, Tenn., (1948).
P. D. Haines, B. & B. Supv., C. & O. Ry., Saginaw, Mich., (1943).
H. C. Halliday, B. & B. Master, Can. Nat'l Ry., Prince Rupert, B. C., Can. (1947)
A. Hamill, B. & B. Master, Esquimalt & Nanaimo Ry., Victoria, B. C., Can., (1948).
A. A. Hampton, Asst. Supv. B. & B., Mo. Pac. Lines, De Quincy, La., (1947).
J. S. Hancock, Br. Engr., D. T. & I. R. R., Dearborn, Mich., (1916).
J. A. Hanson, B. & B. Supv., N. Y. C. Sys., Cincinnati, Ohio, (1947).
***R. J. Hardenbergh**, Draftsman, N. Y. C. Sys., Detroit, Mich., (1949).
C. R. Harding, Pres., The Pullman Co., Chicago (1924)
H. M. Harlow, Asst. Gen. Supv. B. & B., C. & O. Ry., Richmond, Va., (1939).
W. C. Harman, Supv. B. & B., So. Pac. Co., San Francisco, Calif., (1911).
M. J. Harp, Supv. B. & B., Mo. Pac. R. R.. Poplar Bluff, Mo., (1938)
A. R. Harris, Engr. of Bridges, C. & N. W. Ry., Chicago, (1940).
L. M. Hartley, Mast. Carp., S. A. L. R. R., Tampa, Fla., (1948).
G. F. Hartman, Asst. Supv. B. & B., C. & O. Ry., Columbus, Ohio, (1947)
M. S. Harwood, Asst. B. & B. Supv. So. Pac. Co., San Francisco, Calif., (1948)
E. M. Hastings, Ch. Eng., R. F. & P. R. R., Richmond, Va., (1940).
C. L. Hawkins, Asst. Mast. Carp., Penn. R. R., Pittsburgh, Pa., (1950).
J. J. Healy, Asst. B. & B., Supv., B. & M. R. R., Boston, Mass., (1947)
J. E. Heck, Supv. B. & B., C. & O. Ry., Ashland, Ky., (1938)
R. L. Hecker, B. & B. Supv., C. & O. R. R., Grand Ledge, Mich., (1947).
R. D. Hellweg, Asst. Div. Engr., G. M. & O. Ry., Bloomington, Ill., (1947)
B. Hemstad, Mast. Carp., Gr., Nor. Ry., Willmar, Minn., (1937).
H. R. Herrick, B. & B. Supv., So. Pac. Co., Tucson, Ariz. (1941)
C. G. Hill, Asst. Mast. Carp., P. R. R., Steubenville, Ohio, (1946).
R. F. Hill, Supv, B & B., C. I. & L. Ry., Crawfordsville, Ind., (1935).
A. B. Hillman, Engr. M. of W., C. & W. I.-Belt Ry., Chicago, (1942).
P. W. Hofstetter, Asst. B. & B. Supr., M. P. R. R., San Antonio, Tex., (1946).
V. V. Holmberg, Engr. M. of W., C. & W. I. Ry., Chicago (1942).
J. L. Holmes, B. & B. Supr., N. Y. N. H. & H., New Haven Conn., (1949).
F. F. Hornig, Div. Engr., C. M. St. P. & P. R. R. Mason City, Iowa, (1947)
K. E. Hornung, Arch. C. M. St. P. & P. R. R., Chicago, (1949).
N. D. Howard, Secretary, A. R. E. A., Chicago, (1926).
B. J. Howay, B. & B.-W.S., C & O. Ry., Grand Ledge, Mich., (1919)
A. C. Hoyt, B. & B. Engr., E. J. & E. R. R., Joliet, Ill., (1947)

*Junior Member

Long railroad bridge before and after extensive repairs by the B. J. Many Company, Inc.

Time Tested

METHODS AND MATERIALS

- **IN-FIL-TRO Depth Finish, an exclusive B. J. Many Company Inc. system.**
- **Gunite or Shotcrete**
- **Pressure Grouting**
- **Pile Encasement**
- **Weather, Smoke and Fume Protection with IN-FIL-TRO-FLEX**

NEVER, in nearly half a century of extensive research has there been discovered proven methods and materials that provide a more thorough and enduring job of

REPAIRING AND PRESERVING CONCRETE, BRICK AND STONE RAILWAY STRUCTURES

than those employed by the B. J. Many Company, Inc.

Railway structures repaired and fortified against deterioration by the B. J. Many Company, Inc. many, many years ago are today in a high state of preservation . . . furnishing positive proof of the dependable long-lived protection assured by *time-tested* materials and methods.

Upon request, without obligation on your part, a trained B. J. Many Company, Inc. engineer will inspect your bridges and other structures and submit a detailed report of his findings with recommendations.

B. J. MANY COMPANY, Inc.

30 N. LA SALLE STREET, CHICAGO 2, ILL.

WEST LONG BRANCH, N. J. — 409 Monmouth Road
BALTIMORE, MD. — Baltimore Life Bldg.

AUTHORIZED AGENTS

SEATTLE 11, WASH.— Pioneer Sand & Gravel Co., Inc. 901 Fairview Ave. N.
FORT WILLIAM, ONT. — Northland Machinery Supply Co., Ltd., 203 Hardisty St.
WINNIPEG, MANITOBA — Northland Machinery Supply Co., Ltd.

M. J. Hubbard, Gen. Supv. B. & B., C. & O., Ry., Richmond, Va., (1948).
V. T. Huckaby, Steel Br. Insp., M. K. T. R. R. Co., Hillsboro, Tex., (1947)
W. A. Huckstep, Gen Supv., M. P. R. R., St. Louis, Mo., (1941).
N. E. Hueni, Asst. Engr., M. P. R. R., Houston, Tex., (1949).
W. H. Huffman, Div. Engr., C. & N. W. Ry., Chicago, (1941).
F. G. Hull, B. & B. Supv., C. & O. Ry., St. Thomas, Ont., Can., (1947)
R. W. Humphreys, Div. Engr., Nor. Pac. Ry., Missoula, Mont., (1947)
G. R. Hunt, Architect, G. G. & S. F. Ry., Galveston, Tex., (1947)
H. A. Hunt, Resident Engr., T. & N. O. R. R., El Paso, Tex., (1946).
F. C. Huntsman, Div. Engr., Wab. R. R., St. Louis, Mo., (1922).
P. F. Huston, Mast. Carp., Colo. & So., Denver Colo., (1948).
F. W. Hutcheson, Asst. Supv. B. & B., C. & O. Ry., Newport News, Va., (1938).
W. A. Hutcheson, Supv. B. & B., C. & O. Ry., Clifton Forge, Va., (1939).
V. W. Hutchings, B. & B. Supv., S. P. Co., Bakersfield, Calif., (1941).
D. G. Hutchinson, B. & B. Insp., W. P. R. R., Eiko, Nev., (1950).

J. V. Inabinet, Gen. Br. Insp., S. A. L. R. R., Norfolk, Va., (1948).
H. W. Ingram, Field Engr., B. & O. R. R., Pittsburgh, Pa., (1949).
J. A. Inmann, Gen. For. B. & B., St. L. S. F. Ry., Chaffee, Mo., (1947)
D. W. Isaacs, Mast. Carp., C. R. I. & P. Ry., Des Moines, Ia., (1947)

H. E. Jackman, Mast. Carp., B. & O. R. R., Chillicothe, Ohio, (1944).
T. E. Jackson, Gen. B. & B. Supv., So. Pac. Co., San Francisco, Calif., (1948).
W. R. Jacobson, Asst., Engr., M. St. P. & S. S. M. R. R., Stevens Point, Wis., (1948).
M. Jarratt, W. & F. Supr., S. P., Tucson, Ariz., (1950).
H. W. Jenkins, Asst. Div. Engr., N. Y. N. H. & H. R. R., Boston, Mass., (1940).
A. C. Johnson, Supt. B. B., E. J. & E. Ry., Joliet, Ill., (1944)
B. O. Johnson, Asst. Engr., C. M. St. P. & P. R. R., Chicago. (1931).
D. H. Johnson, Supv. B. & B., C. St. P. M. & O. Ry., Altoona, Wisc., (1940).
H. G. Johnson, Asst. Engr., C. M. St. P. & P. R. R., Ottumwa. Ia., (1930).
H. T. Johnson, Asst. Mast. Carp., Penn. R. R., Wilmington, Del., (1949).
R. W. Johnson, Asst. Engr., C. M. St. P. & P. R. R., Chicago, (1922).
A. C. Jones, Supv. B. & B., So. Ry., Jasper, Ala., (1938).
E. B. Jones, Br. Insp., C. & O. Ry., Clifton Forge, Va., (1945).
J. A. Jorlett, Asst. Engr., Penna. R. R., New York, N. Y., (1946).

C. T. Kaier, Gen. Br. Insp., D. L. & W. R. R., Hoboken, N. J., (1937).
W. P. Karwich, Travelling B. & B. Insp., Erie R. R., Akron, Ohio, (1948).
F. A. Kelly, B. & B. Supv., N. Y. N. H. & H., Providence, R. I., (1949).
R. A. Kelso, B. & B. Supv., So. Ry., Valdosta, Ga., (1949).
W. G. Kemmerer, Asst. Engr. B. & B., Penna. R. R., New York, (1931).
J. T. Kendall, Sp. Duty For Penn. R. R., Terre Haute, Ind., (1949).
G. M. Ketchie, Jr., Asst. Engr. Bldgs., So. Ry., Charlotte, N. C., (1948).
L. P. Kimball, Eng. Bldg., B. & O. R. R., Baltimore, Md., (1921).
D. P. Kinzel, Supv. B. & B., N. Y. C. R. R., Delmar, N. Y., (1948).
P. L. Koehler, Asst. Supt., C. & O. Ry., Peach Creek, W. Va., (1938).
W. B. Konkle, For. Carp., Reading Co., Milton, Pa., (1947)
A. S. Krefting, Prin. Asst. Eng., M. St. P. & S. S. M. Ry., Minneapolis, Minn. (1935).
H. H. Kruse, Ch. Carp., C. M St. P. & P. R. R., Mitchell, S. Dak. (1947).
S. E. Kvenberg, Asst. Engr., C. M. St. P. & P. R. R., Chicago, (1932).

J. J. LaBat, B. & B. Supv., Mo. Pac. Ry., Wichita, Kans., (1937)
C. W. Laird, Scale Supt., Mo. Pac. Lines, Houston, Tex., (1947)
L. R. Lamport, Engr. of Mtce., C. & N. W. System, Chicago, (1935).
W. Lampson, Supv., B. & B., Maine Cent. R. R., Portland, Me., (1930).
***R. J. Landregan**, Asst. on Engr. Corps., C. & E. I. Ry., Danville, Illinois, (1950).
W. A. Langford, Asst. Supv. B. & B., Mo. Pac. R. R., Monroe, La., (1948).
J. S. Langston, Mast. Carp., C. R. I. & P. Ry., Little Rock, Ark., (1947)
K. Larson, Supv. B. & B., C. & N. W. Ry., Sioux City, Iowa, (1947).
W. T. League, Mast. Carp., Penn. R. R., Pittsburgh, Pa., (1949).
V. L. Leak, Gen. For. B. & B. & W. S., St. L.-S. F., Tulsa, Okla., (1948).
***C. C. Lederer**, Insp., N. Y. C. Sys., Detroit, Mich., (1949).
J. R. Leguenec, Supv., B. & B., St. L. S. W. Ry., Tyler, Tex., (1948).
F. J. A. Leinweber, B. & B. Mast., Can. Nat'l Rys.. St. Thomas, Ont., Can., (1947).
J. A. Lewis, Supv. B. & B., N. Y. C. Sys., Buffalo, N. Y., (1948).
R. L. Lewis, Supv. B. & B., B. A. & Pac: Ry., Anaconda, Mont., (1948).
F. W. Lichtenberger, Jr., Asst. Mast. Carp., Erie R. R., Paterson, N. J., (1945).
H. J. Lieser, Trk. Supv., Belt Ry. of Chicago, (1948).
G. A. Linn, Div. Engr., C. & N. W. Ry., Chadron, Nebr., (1940).

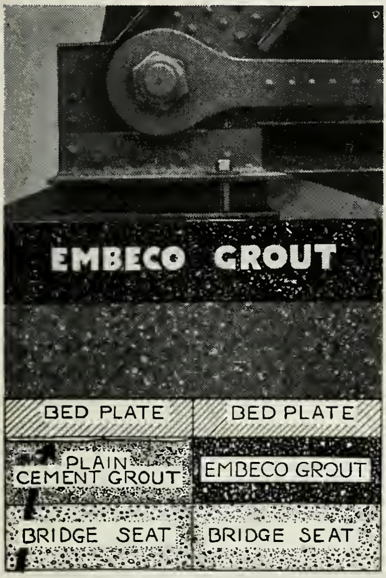
*Junior Member

Non-Shrink

EMBECO

A "B & B" FAVORITE FOR YEARS

Non-Shrink Embeco has no equal for *Speed* and *Permanence* in such operations as . . .



Shrinkage has been the major cause of ordinary grout failure. Poor contact between the grout and bedplate permits increased vibration resulting in more rapid wear and disintegration. Embeco Non-Shrink grout creates an ideal bearing surface that stands up for years.

• • •

- **Grouting Bridge Seats**
- **Repairing Concrete**
- **Repointing Heavy Masonry**
- **Reintegrating Bridge Piers**
- **Waterproofing**
- **Bonding**

The Non-Shrinking and Quick-Setting properties of Embeco saves many MAN-HOURS.

OTHER MASTER BUILDERS PRODUCTS USED EXTENSIVELY by RAILROADS

Pozzolith — Cement Dispersing Agent for mass concrete.

Masterplate — Non-colored and colored armored surface floors.

Omicron Mortarproofing—shrinkage control for masonry mortars.

Masterkure — Membrane curing agent for all concrete.

Write for Pictorial Specifications — available to all Railroad Engineering and Maintenance Men.

THE MASTER BUILDERS COMPANY

CLEVELAND, OHIO • TORONTO, ONTARIO

C. A. **Little**, Asst. Supv. B. & B., B. & M. R. R., Concord, N. H., (1918).
H. C. **Little**, Supv. W. S. I. C. R. R., Vicksburg, Miss., (1948).
G. P. **Lokotzke**, Supv. B. & B., E. J. & E. Ry., Gary, Ind., (1947)
R. J. **Lorber**, Supv. B. & B., P. & P. U. Ry., Peoria, Ill., (1948).
H. T. **Lord**, B. & B. Master, Can. Pac. Ry., Kenora, Ont., (1940)
H. B. **Lorence**, Fire Prot. Engr., C. R. & I. (N. Y. C.), (Gibson), Hammond, Ind., (1950).
R. P. **Luck**, Dftsman, C. & N. W. Ry., Chicago, (1920).
C. V. **Lund**, Asst. Eng., C. M. St. P. & P. R. R., Chicago, (1947).
L. E. **Lyon**, Div. Engr., So. Pac. Co., El Paso, Tex., (1947)

J. F. **McCay**, B. & B. Insp. N. Y. C. Sys. Chicago (1945).
A. A. **McDermott**, B. & B. Supv., So. Pac. Co., Dunsmuir, Calif., (1945).
J. W. **McDonald**, Gen. For. B. & B. W. S., St. L. S. F. Ry,. Springfield, Mo., (1947).
F. O. **McGrew**, Ch. Carp., C. M. St. P. & P. R. R., Terre Haute, Ind., (1948).
E. R. **McKee**, Asst. Div. Engr., B. & O. R. R. Co., Washington, Ind., (1947)
P. F. **McNally**, B. & B. Supv., So. Pac. Co., Ogden, Utah, (1948).
H. C. **Madson**, Designer, C. & N. W. Ry., Chicago, (1940).
C. R. **Malmberg**, Asst. Supv. B. & B., C. & N. W. Ry., Milwaukee, Wisc., (1948).
B. F. **Manley**, Supv. B. & B., Pac. Elec. Ry. Co., Los Angeles, Cal., (1943).
J. A. **Mann**, Asst. Supv. M. W. Eqpt., Mo. Pac. R. R., Palestine, Tex., (1948).
D. A. **Manning**, Supv. B. & B., C. & N. W. Ry., Chicago, (1939).
W. K. **Manning**, Supv. Brs., Erie R. R., Port Jervis, N. Y., (1948).
R. B. **Marshall**, Asst. Engr., C. & O. Ry., Richmond, Va., (1949).
W. F. **Martens**, Supt. Salvage, A. T. & S. F. Ry., Berkeley, Cal., (1924).
G. E. **Martin**, Supt. W. S., I. C. R. R., Chicago, (1942).
J. U. **Martin**, Mast. Carp., S. A. L. R. R., Raleigh, N. C., (1946).
T. J. **Martin**, Gen. Mast. Carp., G. N. Ry., Seattle, Wash., (1940).
E. L. **Mason**, B. & B. Supv., Mo. Pac. Ry. Co., Kingsville, Tex., (1946).
W. G. **Mateer**, Mgr. of Pur. and Stores, E. J. & E. Ry., Chicago, (1944).
R. C. **Mathis**, Br. Inspr., I. C. R. R., Memphis, Tenn., (1947)
A. N. **Matthews**, Gen. For. B. & B. and W. S. St. L. S. F. Ry., Fort Scott, Kans. (1947)
H. A. **Matthews**, Gen. For. B. & B. & W. S., St. L.-S. F., Memphis, Tenn., (1949).
L. E. **May**, Gen. For. B. & B. & W. S., A. T. & S. F. Ry., Fresno, Calif., (1948).
L. **Mayfield**, Asst. Engr. Str., M. P. Lines, Houston, Tex., (1944).
W. R. **Meeks**, B. & B. Supv., M. P. R. R., Falls City, Nebr., (1942).
J. W. N. **Mays**, Mast. Carp., Penn. R. R., Pittsburg, Pa., (1947).
B. W. **Merrill**, Supv. B. & B., N. Y. C. & St. L. R. R., Conneaut, Ohio, (1936).
P. B. **Merwin**, Estimator, C. & N. W. Ry., Chicago, (1927).
E. S. **Meserve**, Asst. Supv., B. & B., B. & M. R. R., Dover, N. H., (1949).
B. R. **Meyers**, Asst. Ch. Engr., C. & N. W. Ry., Chicago, (1930).
H. E. **Michael**, Assoc. Ed. Ry. Engr. & Mtce. Chicago, (1947).
E. L. **Miczanko**, Asst. Gen. For. B. & B. & W. S., A. T. & S. F. Ry., San Bernardino, Calif., (1948).
J. G. **Miller**, Mast. Carp., B. & O. R. R., Connelsville, Pa., (1948).
J. O. **Miller**, Mast. Carp., B. & O. Ry., Flora, Ill., (1945).
R. S. **Miller**, Bld. Supt., C. R. I. & P. Ry., Chicago, (1949).
F. M. **Misch**, Gen. B. & B. Supv., So. Pac. Co., San Francisco, Cal., (1937).
D. N. **Mitchell**, Asst. Supv. B. & B., C. & O. R. R., Newport News, Va., (1948).
W. **Mitchell**, Mast. Carp., Penn. R. R., Harrington, Del., (1949).
E. W. **Moore**, Mast. Carp., C. B. & Q. R. R., Centerville, Iowa, (1942).
I. A. **Moore**, Asst. Chief Engr., C. & E. I. R. R., Danville, Ill., (1937).
J. D. **Moore, Jr.**, Asst. Mast. Carp., Penn. R. R. Philadelphia, Pa., (1947)
J. H. **Morgan**, Engr. M. of W., F. E. C. Ry., St. Augustine, Fla., (1948).
L. R. **Morgan**, Fire Prev. Eng., N. Y. C. R. R., Detroit, Mich., (1937).
E. N. **Morin**, B. & B. Mast., C. P. R., Farnham, Que., (1946).
W. O. **Morris**, Supv. W. S., I. C. R. R., Waterloo, Ia., (1947)
R. H. **Morrison**, Prin. Asst. Engr., B. & A. Ry., Houlton, Me., (1941).
C. L. **Moser**, Supv. B. & B., So. Ry., Asheville N. C., (1948).
C. H. **Mottier**, V.-P. & Ch. Eng., I. C. Sys., Chicago, (1942).

G. W. **Neal**, Supt., Chattahoochee Valley Ry., West Point, Ga., (1948).
E. I. **Nelson**, W. S. For., Mo. Pac. Ry., Nevada, Mo., (1948)
R. A. **Nelson**, Engr. B. & B., C. G. W. R. R., Chicago, Ill., (1948).
W. O. **Nelson**, Asst. Maint. Engr., B. & O. R. R., Baltimore, Md., (1947).
O. P. **Nicely**, Asst. Supv., B. & B., C. & O. Ry., Clifton Forge, Va., (1950).
H. **Norris**, Asst. Supv. B. & B., F. E. C. Ry., Miami, Fla., (1948).
R. L. **Norton**, Mast. Carp., S. A. L. R. R., Savannah, Ga., (1947).
C. O. **Nuckolls**, Ch. Engr. S. S. Ry. Co., Sand Springs, Okla., (1944).

W. C. **Oest**, Prin. Asst. Engr., Ft. .W & D. C. Ry. (Burlington), Ft. Worth, Tex. (1947)
G. **Olson**, Asst. Supt. B. & B., C. & N. W. Ry., Sioux City, Ia., (1944).

Nalco

CHEMICALS and SERVICES for the NATION'S RAILROADS

- **SURVEYS** by experts to determine exact water treatment requirements.
- **LABORATORY RESEARCH** to solve routine problems and to pioneer in new and better water treatment methods.
- **FIELD SERVICEMEN** provide consistent, competent assistance on all water treatment problems.
- **BOILER FEEDWATER TREATMENT CHEMICALS**, exactly compounded to fit specific requirements.
- **DIESEL COOLING SYSTEM TREATMENTS**
- **DIESEL TRAIN HEATING SYSTEM TREATMENTS**
- **FEEDING AND PROPORTIONING EQUIPMENT**
- **TESTING EQUIPMENT**
- **RIGHT-OF-WAY WEED CONTROL SYSTEM**
- **CHEMICAL SOOT REMOVERS**

Nalco ABB System Chemical Ball Feeder is the simple, efficient answer to many railroad water treating problems.

Nalco chemicals are available in liquid, pulverized, or ball-briquet form—to fit all railroad water treatment needs.

Nalco testing equipment is promptly available . . . from a simple stirring rod to a completely equipped Nalco Waterlab.

NATIONAL ALUMINATE CORPORATION
6221 W. 66th Place • Chicago 38, Illinois

Canadian inquires should be addressed to Alchem, Limited, Burlington, Ontario

THE Nalco SYSTEM ...Serving Railroads through Practical Applied Science

V. E. Olson, B. & B. Supv., M. St. P. & S. S. M., Stevens Point, Wis., (1948).
B. J. Ornburn, Engr. & Supt., C. M. St. P. & P. R. R., Chicago, (1948).
T. D. Osbourne, Asst. B. & B. Supv.. So. Pac. Co., Alhambra, Calif., (1943).
C. N. Overdahl, Asst. B. & B. Supv., N. P. Ry., Tacoma, Wash., (1948).
M. P. Oviatt, B. & B. Supv., C. N. O. & T. P. Ry. (S.P.), Lexington, Ky., (1949).
C. Owens, Supv. B. & B., N. Y. O. & W. R. R., Middleton, N. Y., (1948).

*__W. H. Pahl, Jr.,__ Jr. Eng. B. & B. Dept., Penn. R. R., Pittsburgh, Pa., (1950).
A. Parisien, B. & B. Mast., Can. Pac. Ry., Schreiber, Ont.. Can., (1927).
E. Park, Jr., Draftsman, Mo. Pac. Lines, Houston, Tex., (1948)
W. V. Parker, (Retired), Gen. For. B. & B., St. L. S. W. Ry., Memphis, Tenn., (1911).
E. L. Parrish, B. & B. Supv., I. C. R. R., Vicksburg, Miss., (1947)
H. E. Passel, Div. Engr., B. & O. R. R., Indianapolis, Ind, (1948).
E. Patenaude, B. & B. Mast., C. P. R., Sudbury, Ont., Can., (1930).
R. E. Paulson, Ch. Dftsman. C. M. St. P. & P. R. R., Chicago, (1945).
W. E. Pederson, B. & B. Supv., M. St. P. & S. S. M., Superior, Wis., (1950).
J. R. Penhallegon, Asst. Supt. B. & B., C. & N. W. Ry., Chicago, (1940).
L. R. Pennington, B. & B. Supv., C. & N. W. R. R., Chadron, Nebr., (1938).
C. Perry, Asst. Supv. B. & B., C. & O. Ry., Ashland, Ky., (1950).
G. H. Perry, Mast. Carp., Penna. R. R., New York, N. Y., (1948).
N. E. Peterson, Engr. M. of W.. C. & I. M. Ry., Springfield, Ill., (1938)
W. F. Pettys, Div. Engr., Erie R. R., Youngstown, Ohio, (1948).
L. E. Peyser, Architect, So. Pac. Co., San Francisco, Calif., (1937)
A. Pfeiffer, Asst. B. & B. Supv., So. Pac. Co., Sacramento, Calif., (1939).
C. E. Phelps, B. & B. Supv., Georgia R. R., Camak, Ga., (1948).
B. C. Phillips, Mast. Carp., C. B. & Q. R. R., Alliance, Nebr., (1947)
W. J. Phillips, Asst. Gen. Br. Insp., So. Pac. Co., Berkeley. Calif., (1925).
T. W. Pinard, Ch. Engr., Long Island R. R., Jamaica, N. Y., (1920).
N. F. Podas, Ch. Engr., Minn. Trans. Co. & St. Paul Un. Depot Co., St. Paul, Minn., (1937).
H. M. Potts. Mast. Carp., B. & O. R. R., Wheeling, W. Va., (1946).
R. G. Preston, Asst. Engr., Penn. R. R., Chicago, (1947)
G. H. Priest, Gen. For. B. & B., Can. Nat. Ry., Belleville, Ont., Canada, (1948).
C. R. Pritchard, Asst. Arch., So. R. R., Charlotte, N. C., (1948).
W. H. Pryor, Gen. For. B. & B. and W. S., St. L.-S. F. Ry., Memphis, Tenn., (1946)

W. H. Rainey, Asst. B. & B. Supv., T. & N. O. R. R., San Antonio, Tex., (1947).
W. F. Raley, Mast. Carp., B. & O. R. R., Callery, Pa., (1949).
L. F. Rapier, Supv. B. & B., G. M. & O. R. R., Bloomington, Ill., (1946).
G. W. Rear, Jr., Asst. Gen. Fire Insp., Sou. Pac. Co., San Francisco, Calif., (1939).
A. N. Reece, Asst. to Pres., K. C. S. Ry., Kansas City, Mo., (1922).
A. D. Reed, Mast. Carp., C. B. & Q. R. R., McCook, Nebr., (1945).
C. J. Reed, Supv. B. & B., N. Y. C. Sys., Detroit, Mich., (1949).
F. A. Reed, Supv. B. & B., I. C. R. R., Clinton, Ill., (1947)
A. G. Reese, Dist. Maint. Engr., C. B. & Q. R. R., Galesburg, Ill., (1947)
O. C. Rhoades, Asst. Supv. B. & B., C. & N. W. Ry., Fond du Lac, Wisc., (1947).
E. D. Rice, Br. Insp., C. & E. I. Ry., Danville, Ill., (1949).
C. A. J. Richards, Mast. Carp., Penna. R. R., Grand Rapids. Mich., (1924).
H. B. Richardson, B. & B. Supv., B. & M. R. R., Dover, N. H., (1948).
D. T. Rintoul, Gen. Br. Insp., So. Pac. Co., San Francisco, Calif., (1910).
C. A. Roberts, Ch. Draftsman, Erie R. R., Cleveland, Ohio, (1948).
J. J. Robertson, Gen. For. B. & B., C. N. R., Stratford, Ont., Canada, (1949).
B. L. Robinson, Conc. Asst., A. A. R., 59 E. Van Buren St., Chicago, (1948).
G. E. Robinson, Engr. of Structs., N. Y. C. System, Chicago, (1948).
N. R. Robinson, B. & B. Supv., So. Pac. Co., Sacramento, Calif., (1934).
L. A. Rode, Gen. Br. Insp., Erie R. R., Newark, N. J., (1948).
H. W. Routenberg, Mast. Carp., B. & O. R. R., Baltimore, Md., (1946).
R. T. Rumbold, B. & B. Supv., So. Ry., Greensboro, N. C., (1947)
C. E. Russell, Supv. W. S., Ill. Cent. R. R., Chicago, (1944).
G. M. Ryan, B. & B. Supv., N. Y., N. H. & H. R. R., Boston, Mass., (1947)

J. R. Safley, Asst. B. & B. Supv., So. Pac. Co., Dunsmuir, Calif., (1945)
J. M. Salmon, Chief Eng., Clinchfield R. R., Erwin, Tenn., (1938).
T. D. Saunders, Ch. Engr., Ontario Northland Ry., North Bay, Ont., Can., (1930).
W. J. Savage, Asst. Chf. Engr., T. & P. Ry., Dallas, Tex., (1948).
P. J. Scherer, Supv. B. & B., So. Pac. Co., El Paso, Tex., (1936).
J. F. Scheumack, Asst. B. & B. Supv., T. & N. O., Houston, Tex., (1950).
F. F. Schilt, Asst. Div. Engr., B. & O. R. R., Grafton, W. Va., (1946).
E. R. Schlaf, Asst. Supt. W. S., I. C. R. R., Chicago, (1947).
C. E. Schofield, Asst. Mast. Carp., S. A. L. R. R., Savannah, Ga., (1948).

*Junior Member

FOR A LONGER-LASTING PAINT JOB

Specify Flame-Cleaning

Thorough cleaning and drying of steel surfaces is assured when Oxweld's flame-cleaning method is used. In this procedure, high-temperature oxy-acetylene flames are passed over the work, dislodging dirt and soot, evaporating all moisture, and causing scale and rust to expand and pop off. The surface is then wire-brushed and painted while warm. This provides a more lasting paint job than when other metal-cleaning methods are used, for paint bonds tighter, spreads more evenly, and dries more quickly when applied to warm, dry metal.

The ease of applying Oxweld's flame-cleaning . . . plus the high quality of the results obtained . . . have led to the use of this method to clean and dry all types of structural steelwork — train sheds, bridges, pipe, tanks, rail that is to be covered, and rolling stock of all kinds. Ask an Oxweld representative for information regarding a demonstration.

THE OXWELD RAILROAD SERVICE
COMPANY
Unit of Union Carbide and Carbon Corporation
UCC
Carbide and Carbon Building
Chicago and New York

OXWELD
RAILROAD SERVICE

SINCE 1912—THE COMPLETE OXY-ACETYLENE SERVICE FOR AMERICAN RAILROADS

D. E. Schreiber, Fore. W. S., M. P. R. R., Jefferson City, Mo, (1948).
A. W. Schroeder, Chf. Engr., C. & E. I. Ry., Danville, Ill., (1949).
P. E. Scites, Asst. Supv. B. & B., C. & O. Ry., Huntington, W. Va., (1950).
L. L. Seley, Mast. Carp., C. B. & Q. R. R.. Hannibal, Mo., (1947).
A. D. Shackelford, Div. Engr., C. N. R., Dauphin, Man., Canada, (1950).
L. A. Shaefer, Fore. W. S., M. P. R. R., Osawatomie, Kan., (1948).
C. J. Shapland, Asst. Engr., B. & B., C. V. Ry., (Can. Nat'l. Rys.), St. Albans, Vt., (1945)
S. H. Shepley, Asst. Chief Engr., E. J. & E. Ry., Joliet, Ill., (1945).
F. Shobert, Sys. Steel Const. Frm., So. Pac. Co., Oakland, Cal., (1918).
J. R. Showalter, Br. Engr., M. P. R. R.. St. Louis, Mo., (1942).
F. A. Siegfried, For. Carp. B. & B., Reading Co., Reading, Pa., (1947)
E. W. Simpson, Steel Br. Insp., A. T. & S. F. Ry., Los Angeles, Calif., (1948).
P. X. Simpson, Supv B. & B., Nor. Pac. Ry., Tacoma, Wash., (1947)
C. C. Sims, Supv. B. & B., C. & O. Ry.,Hinton, W. Va., (1947)
E. W. Singer, Supv. B. & B., N. Y. C. & St. L. R. R., Fort Wayne, Ind., (1923).
A. A. Sirel, Br. Asst., A. A. R., Chicago, (1940).
G. L. Sitton, Asst. Ch. Engr., So. Ry. Sys., Washington, D. C., (1920).
H. E. Skinner, Supv. S. & W. Equip., E. J. & E. Ry., Joliet, Ill., (1944).
G. P. Slagle, Ch. Carp., C. M. St. P. & P. R. R., Milwaukee, Wis., (1948).
F. M. Sloane, Div. Eng., C. M. St. P. & P. R. R. Co., Milwaukee, Wis., (1927).
B. Smart, Trk. Supv., D. T. & I. R. R., Dearborn, Mich., (1945).
C. A. Smith, Supv. B. & B., C. R. & I.-I. H. B. R. R., Hammond, Ind., (1946)
H. E. Smith, Engr. M. of W., G. H. & H., Galveston, Tex., (1941).
J. Smith, Asst. B. & B. Supv., So. Pac. Co., Sacramento, Cal., (1943).
L. C. Smith, Div. Engr., C. & N. W. Ry., Madison. Wis., (1942)
L. L. Smith, Asst. B. & B. Supv., So. Pa. Co., Dunsmuir, Calif., (1948).
R. H. Snow, Gen. For., Maine Cent. R. R., Waterville, Maine, (1947)
E. F. Snyder, Div. Engr., I. C. R. R., Champaign, Ill., (1948).
R. H. Snyder, Trainmaster, So. Ry., Valdosta, Ga., (1946).
T. E. Snyder, Mast. Carp., B. & O. R. R., Salamanca, N. Y., (1949).
G. R. Sproles, Div. Engr., L. & N. R. R., Mobile, Ala., (1948).
F. R. Spofford, Asst. Div. Engr., B. & M. R. R., Dover. N. H. (1940).
H. A. Springel, Asst. B. & B. Supv., Mo. Pac., Falls City, Nebr., (1950).
R. Srb, Mast. Carp., C. B. & Q. R. R., Lincoln, Nebr., (1949).
W. B. Starnes, Br. Inspr., Mo. Pac. Lines, Kingsville, Tex., (1947)
G. T. Steidel, Br. Eng., L. & N. E. R. R.. Bethlehem. Pa., (1946).
B. M. Stephens, Asst. to Ch. Engr., T. & N. O. R. R., Houston, Tex., (1946).
O. W. Stephens, Asst. to Chief Eng., D. & H. R. R., Albany, N. Y., (1929).
F. J. Stewart, Chief Engr., Port Everglades Belt Line Ry., Port Everglades (Ft. Lauderdale), Fla., (1944).
W. Stoneman, Jr., Asst. B. & B. Supv., So. Pac. Co., El Cerrito, Calif., (1948).
J. A. Strouss, Asst. B. & B. Supv., Sou. Pac. Co., Sacramento, Calif., (1934).
J. W. Stutzman. For. Carp., Reading Co., Reading, Pa., (1947)
J. Sumner, W. S. Fore., St. L. S. F. Ry., Springfield, Mo., (1948).
W. A. Sweet, Gen. Frm. B. & B., A. T. & S. F. Ry., Newton, Kans., (1928).
G. Switzer, Asst. Div. Engr., W. P. R. R., Eiko, Nev., (1949).

C. R. Taggart, Supv. B. & B., N. Y. C. Sys., Indianapolis, Ind., 1935).
C. L. Tanner, Gen. For. B. & B. & W. S., P. & S. F., Slaton, Tex., (1948).
E. E. Tanner, Gen. Supv., B. & B., N. Y. C. Sys., Albany, N. Y., (1938).
E. R. Tattershall, Supt. Mtce. Eqpt., N. Y. C., Sys., New York, N. Y., (1913).
R. S. Templin, For. Carp., Reading Co., Pottsville, Pa., (1947)
L. J. Tetreault, B. & B. For., N. Y. N. H. & H. R. R., Worcester, Mass., (1936).
P. V. Thelander, Asst. Engr. of Mtce., C. & N. W. Ry., Chicago, (1939).
F. W. Thompson, Ch. Engr., C. R. I. & P. Ry., Chicago, (1946).
S. R. Thurman, Supv. B. & B., Mo. Pac. R. R., Nevada, Mo., (1943).
D. C. Todd, Mast. Carp., Penna. R. R., Pittsburgh, Pa., (1942).
O. G. Todd, Asst. Div. Engr., B. & O. R. R., Garrett, Ind., (1946).
E. B. Tourtelotte, Supv. B. & B., B. & M. R. R., Greenfield, Mass., (1947).
D. E. Tracy, Asst. B. & B. Supv., So. Pac. Co., Bakersfield, Calif., (1946).
J. D. Trulove, Senior Asst. B. & B. Supv., So. Pac. Co., Ogden, Utah, (1945).
N. R. Tucker, Asst. Div. Engr., T. & N. O. R. R., (So. Pac. Lines) Lafayette, La., (1939)
H. C. Tunison, Asst. Engr. M. of W., L. & N. E. R. R., Bethlehem, Pa., (1946).
A. E. Tupper, B. & B. For., So. Pac. Co., Stockton, Calif., (1942).
W. L. Turner, Jr., Assoc. Ed. Railway Age., New York, N. Y., (1946).
J. F. Twomey, Mast. Carp., Penn. R. R., Chicago, (1948).

R. M. Vance, Asst. Sup. B. & B., N. F. & G. (C. & O.), Rainelle, W. Va., (1949).
E. C. Vandenburgh, Chief Engr., C. & N. W. Ry., Chicago, (1925).
R. A. Van Ness, Br. Engr. Sys., A. T. & S. F. Ry., Chicago, (1949).
J. L. Varker, Div. Engr., D. & H. R. R., Carbondale, Pa., (1936)
H. L. Veith, B. & B. Supv., So. Ry., Birmingham, Ala., (1942).

Protect Timber Bridges and Trestles From Grass and Weed Fires...Use

BORASCU®

...the Concentrated Borate Ore

FOR EFFECTIVE WEED CONTROL

Do away with fire-hazardous weeds and grasses about timber bridges and trestles, tie piles and buildings the thrifty, modern way . . . with BORASCU! Eliminate costly, labor-consuming, shovel-cutting operations too by using safe, non-corrosive, and economical BORASCU . . . the low-priced concentrated borate ore.

BORASCU is the ideal chemical because it is non-selective and destroys most all vegetation. When correctly used, BORASCU should prevent the growth of vegetation for 12 to 24 months, or longer. BORASCU is applied dry, just as it comes from the convenient, easily disposable, 100-lb. bags. Your section hands can apply BORASCU, without tieing up tracks and equipment, by following simple directions. A common 12-quart pail and BORASCU are all that is required to eliminate weeds and grasses.

- *Start your economy in weed control now ... write at once for your copy of the latest Borascu bulletin containing full information and address of our Weed Control Field Office nearest to you.*

PACIFIC COAST BORAX CO.
DIVISION OF BORAX CONSOLIDATED, LIMITED
510 WEST SIXTH STREET • LOS ANGELES 14, CALIFORNIA

R. E. Ventress, Mast. Carp., G. M. & O. Ry., Springfield, Ill., (1946).
T. M. Von Sprecken, Asst. to Ch. Engr., So. Ry., Washington, D. C., (1938).
J. S. Vreeland, Sales Repr., Ry. Engr. & Mtce., New York, (1940).

R. E. Wait, Supv. B. & B., Wabash R. R., Decatur, Ill., (1923).
C. M. Walker, B & B Master, C. N. R. Moncton, N. B. Can., (1949).
G. Walker, Asst. B. & B. Supv., Mo. Pac. Lines, Palestine, Tex., (1941).
G. P. Walker, Supv. B. & B., Mo. Pac. Ry., Monroe, La., (1929).
H. D. Walker, Prin. Asst. Engr., I. C. C. R. R., Chicago, (1947)
E. G. Wall, Div. Engr., G. M. & O. Ry., Bloomington, Ill., (1942)
R. Wall, Supv., B. & B., So. Ry., Selma, Ala., (1948).
C. E. Wallace, Gen. For. B. & B. & W. S., S. L. S. F. Ry., Ft. Smith, Ark., (1948).
J. A. Walsh, Mast. Carp., Reading R. R., Philadelphia, Pa., (1948).
J. J. Walsh, Mast. Carp., C. B. & Q. R. R., Beardstown, Ill., (1942).
W. B. Warfield, Mast Carp., Penn. R. R., Buffalo, N. Y., (1947)
J. F. Warrenfells, Mast. Carp., S. A. L. R. R., Savannah, Ga., (1946).
W. M. Warso, Engr., Monongahela Connecting R. R., Pittsburgh, Pa., (1948)
L. W. Watson, Dist. Br. Insp., B. & O. R. R. Co., (Mt. Lebanon), Pittsburgh, Pa., (1944).
J. E. Weatherly, Sr., Div. Engr., T. & N. O., Houston, Tex., (1950).
G. R. Webber, Ch. Carp., C. M. S. P. & P. R. R., Spokane, Wash., (1948).
D. A. Webster, Asst. Engr., D. & H., R. R., Albany, N. Y., (1950).
T. J. Webster, Mast. Carp., C. R. I. & P. Ry., Kansas City, Mo., (1941).
D. E. Weidner, For. Carp., Reading Co., New Cumberland, Pa., (1947).
J. W. Welch, Supv. B. & B., F. E. C. Lines, St. Augustine, Fla. (1943).
W. M. Wells, Asst. Div. Eng., B. & O. R. R., Washington, Ind., (1946).
O. C. Wentling, B. & B. Inspr., N. Y. C. Lines, Chicago, (1947)
J. R. Wenzel, Asst. Supv. B. & B., C. & N. W. Ry., Boone, Iowa, (1946).
G. H. West, Term. For., West. Maryland Ry., Waynesboro, Pa., (1947)
R. A. Westergren, Mast. Carp., Penn. R. R., Terre Haute, Ind., (1947).
J. W. Westwood, Div. Engr., N. Y. C. Lines, Detroit., (1941)
J. C. White, Div. Engr., N. Y. C. Lines, Indianapolis, Ind., (1947)
L. H. White, B. & B. Supv., Ill. Cent. R. R., Carbondale, Ill., (1946).
S. White, B. & B. Supv., So. Pac. Co., Tucson, Ariz., (1942).
B. M. Whitehouse, Ch. Fire Insp., C. & N. W. Ry., Chicago, (1927).
R. V. Wickman, Supv. B. & B., B. & A. Ry., Pittsfield, Mass., (1948)
***F. F. Widrig**, Designer, N. Y. C. Sys., Detroit, Mich., (1949).
A. Wiitala, Gen. For., B. & B., L. S. & I. Ry., Marquette, Mich., (1941).
Wm. Wilbur, Div. Engr., C. & N. W. Ry., Green Bay, Wis., (1947).
C. Williams, Asst. Supv. B. & B., C. & O. R. Y., Ashland, Ky., (1950).
N. H. Williams, B. & B. Supv., D. & H. R. R., Oneonta, N. Y., (1947)
W. T. Williams, B. & B. Supv., T. & N. O. R. R., Ennis, Tex., (1947)
R. P. Wilson, Asst. Supv., B. & B., C. & O. Ry., Hinton, W. Va., (1948).
L. C. Winkelhaus, Arch. Eng., C. & N. W. Ry., Chicago, (1934).
F. J. Wirges, Mast. Carp., C. R. I. & P. Ry., El Reno, Okla., (1948).
H. A. Wistrich, Asst. Ch. Engr., L. V. R. R., New York, (1938).
J. P. Witherspoon, Asst. Mast. Carp., S. A. L. R. R., Atlanta, Ga., (1948).
J. E. Wolfe, Steel Br. Insp., M. K. T. of T., Dennison, Tex., (1950).
F. R. Woolford, Ch. Engr., W. P. R. R., San Francisco, Cal., (1950).
H. O. Wray, Engr. M. W. & S., Tex. City Trml. Ry., Texas City, Tex., (1939).
H. Wrights, Supv. B. & B., Mo. Pac. Ry., Little Rock, Ark., (1929)

J. E. Yewell, Chief Engr., B. & L. E. R. R., Greenville, Pa., (1941).

R. O. Zittrouer, Mast. Carp., S. A. L., Atlanta, Ga., (1949).

*Junior Member

LIFE MEMBERS

P. Aagaard, Supv. Bldg., I. C. R. R., 6826 S. Dante, Chicago, (1906)
R. D. Anderson, Div. Engr., C. & N. W. Ry., Huron, S. D., (1923)
W. J. Azer, Supv. B. & B., C. & N. W. Ry., W. Chicago, Ill., (1920)

W. A. Batey, Con. Engr., U. P. R. R., 4303 South St., Lincoln, Neb., (1918).
F. Brie, Steel Br. For., P. M. Ry., 2418 Casper, Detroit, Mich. (1922).
W. Buckingham, Br. For., M. C. R. R., 907 Chittock Ave., Jackson, Mich., (1928)

J. P. Canty, Asst. to Eng. M. W., B. & M. R. R., Melrose, Mass., (1901).
H. M. Church, Gen. Supv., B. & B., C. & O. Ry., 509 N. Boulevard, Richmond, Va., (1939).

RAILROAD MEN KNOW

Likewise, Heating Engineers and Contractors know that it takes experience to build good systems to convey hot or cold materials. That's one reason why Ric-Wil Prefabricated Insulated Piping Systems have the call in the "controlled temperature" piping field. Backed by 40 years of "know how", Ric-Wil prefabricated piping units are tailored to fit every railroad requirement on insulated piping.

For years Ric-Wil engineering service has been utilized for planning and field installation assistance for roundhouse, switch yards and other railroad service piping systems. The many types of systems now in operation are setting new standards for high operating efficiency and low maintenance costs.

Upon request, our representative will be glad to provide detailed technical information as related to your specific problem.

RIC-WIL
INSULATED PIPING SYSTEMS
OVERHEAD — THE RIC-WIL COMPANY · CLEVELAND, O. — UNDERGROUND

FOR FORTY YEARS THE GREATEST NAME IN INSULATED PIPING SYSTEMS

J. B. Clancy, Supv. Bldgs, D. & H. R. R., 924 Melrose Ave., St. Petersburg, Fla., (1930).
W. A. Clark, Off. Engr., D. M. & I. R. R., 2718 E. 5th St., Duluth, Minn., (1908)
S. T. Corey, Off. Engr. & Engr. of Bridges, C. R. I. & P. R. R., 7250 Harvard Ave., Chicago, (1921).
G. M. Cota, Chf. Clk. Eng. Dept., C. Vt. Ry., St. Albans, Vt., (1913)
G. S. Crites, Div. Engr., B. & O. R. R., 4409 Underwood Rd., Baltimore, Md., (1912)

E. G. Day, Ch. Engr., L. S. & I. R. R., 450 E. Ridge St., Marquette, Mich., (1923).
H. H. Decker, Res. Engr., C. & N. W. Ry., 2915 Ingersoll Ave., Des Moines, Ia., (1908).
E. Drury, Gen. For. B. & B., A. T. & S. F. Ry., Newton, Kans. (1919)
H. A. Elwell, Supt. B. & B., C. G., W. Ry., 1736 Marshall Ave., St. Paul, Minn. (1911)

M. J. Flynn, Supv. B. & B., C. & N. W. Ry., 2445 Coyle Ave., Chicago, (1905)

B. F. Gehr, Mast. Carp., Penn. R. R., 400 S. 14th St., Richmond, Ind., (1908).
I. Gentis, For. B. & B., So. Pac. Co., 2004 West St., Oakland, Calif., (1912)
H. A. Gerst, Asst. Engr. G. N. Ry., 748 Aldine St., St. Paul, Minn., (1917)
J. E. Gillette, Carp. For., C. M. St. P. & P. Ry., Mazomanie, Wis., (1923)
A. D. Gillis, B. & B. Supv., N. Y. N. H. & H., Providence, R. I., (1923).
O. C. Gongoll, Supv. B. & B., M. St. P. & S. S. M. Ry., 2630½ Dupont Ave., Minneapolis, Minn., (1917).
B. A. Guill, Supv. B. & B. Georgia R. R., Camok, Ga., (1901)
E. Gunderson, Supv. B. & B., C. St. P. M. & O. Ry., Altoona, Wis., (1927).

T. L. D. Hadwen, Engr. Masonry Constr., C. M. St. P. & P. Ry., 1140 N. La Salle, Chicago, (1907)
Geo. W. Hand, Asst. to Pres., C. & N. W. Ry., 412 Courtland Ave., Park Ridge, Ill. (1909).
J. R. Hartwell, Supv. B. & B., C. & N. W. Ry., Pierre, S. D., (1918)
Heizenbuttel, B. & B. Supv., C. & N. W. Ry., 808 So. 3rd St., Norfolk, Nebr., (1917)
C. W. Heuss, Supv. B. & B., C. C. C. & St. L. Ry., 1840 Lexington, Indianapolis, Ind., (1919)
F. W. Hillman, Asst. Engr., M. of W., C. & N. W. Ry., Evanston, (1917).
J. P. Hofacker, Supv. B. & B., L. V. Ry., 54 N. Fulton St., Auburn, N. Y., (1907)
H. A. Horning, Asst. Supt. Bldgs., M. C. R. R., 1106 Francis St., Jackson, Mich., (1902)
J. S. Huntoon, Asst. Br. Engr., Mich. Cent. R. R., 250 Grove Ave., Highland Park, Mich., (1915).

B. L. Johnson, Gen. Mast. Carp., G. N. Ry., 1007 W. 18th St., Spokane, Wash., (1919)
Maro Johnson, Prin. Asst. Engr., I. C. R. R. c/o Casa de Fresa, Hammond, La., (1915).
S. J. Johnson, Supv., B. & B., M. & St. L. R. R., 408 N. Center St., Marshalltown, Iowa, (1922)

E. J. Knetzger, For. B. & B., So. Pac. Co., 3140 E. 27th St., Oakland, Calif., (1926)
H. L. Koch, Supv. B. & B., N. Y. C. & St. L. Ry., Conneaut, Ohio, (1922)

W. J. Lacey, B. & B. Sup., Mo. Pac. Ry., 4370 Swan St., St. Louis, Mo., (1911)
W. S. Lacher, Sec., A. R. E. A., Chicago, (1922).
C. A. Landstrom, Supv., B. & B., C. B. & Q. R. R., 1311 So. 3rd St., Burlington, Iowa, (1928).
H. M. Large, Mast. Carp., Penn. R. R., 511 Geddings Ave., Grand Rapids, Mich., (1908)
H. C. Larsen, Str. Iron Foreman, C. St. P. M. & O. Ry., 1084 Sims Ave., St. Paul, Minn., (1928).
S. Lincoln, Gen. For. B. & B., G. C. & S. F. Ry., 1903 Harrison Ave., Beaumont, Tex., (1927)
C. G. Lindstrom, For. B. & B., C. M. St. P. & P. Ry., Rockwell City, Iowa, (1924)
C. R. Lyman For. B. & B., Central Vermont Ry., Waterbury, Vt., (1913)

F. H. Masters, Ch. Engr., E. J. & E. R. R., 907 Glenwood Ave., Joliet, Ill., (1920).
E M. McCabe, Supv. B. & B., B. & A. R. R., 205 Murray St., New Smyrna Beach, Fla., (1915).
G. G. McCue, Supv. B. & B., G. T. R. R., 369 Main St., Ottawa, E. Ont., (1913)
H. A. McElhinney, B. & B. Mast., C. N. Ry., 9 Beech St., Halifax, N. S., (1923)

GEORGE VANG, INC.

RAILROAD
AND
BRIDGE CONSTRUCTION

623 GRANT BUILDING «» PITTSBURGH, PA

W. E. CRAWFORD
PRESIDENT

A. G. McKay, Supv. B. & N. Y. N. H. & H. R. R., 11 Pine Island Road, Jupiter Pt. Groton, Conn., (1915).
T. D. McMahon, Architect, G. N. Ry., 223 Lake Ave., White Bear Lake, Minn., (1918)
H. C. McNaughton, Supv., B. & B., B. & M. R. R., Greenfield, Mass., (1915).
E. L. Mead, Div. Engr., C. & N. W. Ry., 536 N. E. 69th St., Miami, Fla., (1923)
J. Mellgren, For. W. S., C. & N. W. Ry., 523 N. Caldwell Ave., Eagle Grove, Iowa (1913)
C. E. Miller, Asst. Engr., M. of W., C. & N. W. Ry., 400 Ridge Ave., Evanston, Ill., (1916).

A. B. Nies, Architect, Mich. Cent. R. R. (NYC), 408 Third St., Jackson, Mich., (1915)

W. J. O'Brien, Dist. Carp., C. M. St. P. & P. Ry., Necedah, Wisc., (1919).
J. A. Owen, For. B. & B., D. & M. Ry., E. Tawas, Mich., (1915).

P. Paulson, Supv. B. & B., C. & N. W. Ry., 547 Simmons Ave., S. E., Huron, S. D., (1923)
C. Piccone, Engr. of Brs., Nat. Rys. of Mex., Mont. Everest, 210 Lomas De Chap, Mexico City, Mex., (1923).

D. L. Rehmert, Mast. Carp. Penn. R. R., 104 W. 3rd Ave., Columbus, Ohio, (1918).
A. O. Ridgway, Ch. Engr., D. & R. G. W., University Club, Denver, Colo., (1910).
H. T. Rights, Asst. Brg. Eng., L. V. R. R., 1015 Raymond Ave., Bethlehem, Pa., (1927).
W. R. Roof, Br. Engr., C. G. W., R. R., 7728 Yates Ave., Chicago, (1927).
O. F. Rowland, Asst. Engr., D. & H. R. R., c/o Industrial Farm, Canaan, N. Y., (1923)

F. B. Scheetz, Asst. Engr., Mo. Pac., Ry., 3930 Connecticut Ave. Washington, D. C., (1905)
I. L. Simmons, Br. Engr., C. R. I. & P. Ry., Winter Park, Fla., (1913)
C. E. Smith, V. P., N. Y., N. H. & H., 282 Prospect St., New Haven, Conn., (1911).
C. U. Smith, Consulting Engr., P. O. Box 953, Lindsay, Calif., (1915).
D. Speaker, Mast. Carp., Penna. R. R., 813 N. 4th St., Steubenville, Ohio, (1928).
T. H. Strate. Div. Engr., C. M. St. P. & P. R. R., 6753 N. Sioux Ave., Chicago, (1918).
H. B. Stuart, Str. Engh., G. T. Ry., 4205 Dorchester St., Westmount, Que., Can., (1913)

J. L. Talbott, Gen. For. B. & B., A. T. & S. F. Ry., Pueblo, Colo., 228 Park St., Morgantown, W. Va., (1905)
F. A. Taylor, Mast. Carp., B. & O. R. R., 2970 Mattern Ave., Pittsburgh, Pa., (1909)

W. H. Vance, Asst. Engr, M. of W., M. P. R. R., 6347 Alamo Ave., Clayton, Mo., (1910).
E. J. Vincent, For. B. & B., So. Pac. Co., 1740 So. Hoover, Los Angeles, Calif., (1911)
H. VonSchrenk, Const. Tbr. Engr., D. L. & W. Ry., 509 Chouteau Bldg., St. Louis, Mo., (1916).

W. H. Walden, Rdm., Sou. Ry., 1012 Porter St., Richmond, Va., (1920)
L. A. Warren, Supv., B. B., So. Pac. Co., Del Paso Heights, Calif., (1929).
W. Watson, Supv., B. & B., E. J. & E. Ry., Joliet, Ill., (1930)
F. W. White, Supv. B. & B., L. V. R. R., 409 S. Wilbur Ave., Sayre, Pa., (1915)
W. E. White, Gen. For., A. T. & S. F. Ry., Chanute, Kans., (1920).
J. J. Wishart, Supv., B. & B., N. Y. N. H. & H., 21 Elmlawn Rd., Braintree, Mass., (1915)
C. F. Womeldorf, Div. Engr., C. & N. W. Ry., 111 No. 12th St., Norfolk, Nebr., (1917)
C. W. Wright, Mast. Carp., L. I. R. R., 67 Nassau Parkway, Oceanside, N. Y., (1908)
H. Wuerth, Div. Engr., C. M. St. P. & P. R. R., Savanna, Ill., (1919)

R. C. Young, Ch. Engr. L. S. & I. R. R., 719 Pine St., Marquette, Mich., (1907).

E. C. Zinmeister, Mast. Carp., B. & O. R. R., 312 Tenth St., N., St. Petersburg, Fla., (1905)

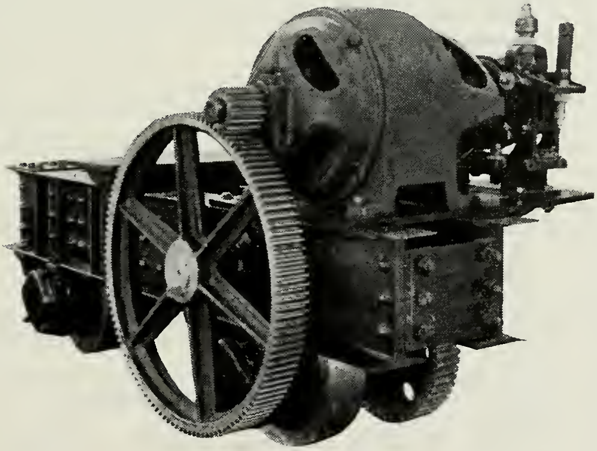
TURNTABLES or DRIVING TRUCKS

Constructed to Reduce Maintenance

Bronze disc center, oil sealed.

In new Turntables or in old center bearing types converted to three point operation the same rugged working parts are employed.

Equalized roller bearing equipped drive units can be depended on for permanent efficient performance.



Powerful Turntable Driving Truck. Built to Handle the Heaviest Loads.

R. W. YOUNG MFG. CO.

20 NO. WACKER DRIVE
CHICAGO 6, ILLINOIS

CHARTER MEMBER

G. W. Gooch, (retired), 1325 W. 9th St., Des Moines, Ia., (1891)

HONORARY MEMBERS

Ralph Budd, (Retired) Chf. Exec. Off., C. B. & Q. R. R., Chicago, (1927).
Charles H. Buford, Pres., C. M. St. P. & P. Ry., Chicago, (1946).
C. E. Johnston, (Retired) Chairman, West. Assoc. Ry. Ex., La Jolla, Calif., (1911).

ASSOCIATE MEMBERS

L. Adams, Oxweld Railroad Service Co., 230 N. Michigan Ave., Chicago, (1943).
J. H. Allen, Fld. Engr. Fin. Div., E. I. Du Pont de Nemours & Co., Briar Hill, Malvern, Pa., (1949).
W. P. Arnold, Asst. to V.-P. (Wood Preservg. Div.), Koppers Co., Inc., Pittsburgh, Pa., (1946).

G. H. Bailey, Mgr. R. R. Div., Morrison-Knudsen Co., 1718 No. 15th St., Boise, Idaho
D. L. Baker, V.-P., Baker & Hickey Co., 85 E. Gay St., Columbus, Ohio, (1946).
A. E. Bardwell, West Div. Mgr., Fabreeka Products Co., 325 W. Huron St., Chicago 10, Ill., (1946).
R. H. Bescher, Mgr. of Tech. Dept., Wood Pres. Div., Koppers Co., Inc., Koppers Bldg., Pittsburgh, Pa., (1948).
G. R. Betts, Mgr. R. R. Sales, Armco Drainage & Metal Prod., Inc., 310 S. Michigan Ave., Chicago, (1946).
D. B. Bishop, Sales Eng., Dearborn Chemical Co., 1512 Farmers Bank Bldg., Pittsburgh, Pa., (1946).
A. Boldt, Cont. Lum. Sales, No. 2 W. Cutting Boul., Richmond, Calif., (1949).
J. D. Bolton, J. D. Bolton & Co., 20 N. Wacker Dr., Chicago, (1946).
Chas. H. Borcherding, Sr., Field Engr., The Master Builders Co., 13 W. 25th St., Baltimore 18, Md., (1947).
C. R. Boulton, R. R. Contractor, 15 E. Town St.. Columbus, Ohio, (1946).
J. P. Burkey, Con. Engr., Union Metal Mfg. Co., 2421 Plymouth Ave., Columbus, Ohio, (1942).
G. C. Buskirk, Repr. Pacific Borax Co., 4705 France Ave., So., Minneapolis 10, Minn, (1949).

J. F. Canning, V. P., Southwestern Petroleum Co., P. O. Box 789, Ft. Worth, Tex., (1949).
J. E. Carroll, Mgr. Constr. Eqpt. Div., Harron Rickard & McCone Co. of Sou. Calif., 3850 Santa Fe Ave., Los Angeles, Calif., (1945).
K. J. Clapp, Asst. Sales Mgr., Homelite Corp., Port Chester, N. Y., (1946).
R. Clarke, Res. Mgr., Massey Conc. Prod. Co., 122 S. Mich. Ave., Chicago, (1948).
H. S. Claybaugh, Div. Engr. Armco Drainage & Metal Prod., Inc., 4345 Lyndale Ave., Minneapolis, Minn., (1946).
R. R. Clegg, Dist. Sales Mgr., American Lumber & Treating Co., 332 S. Michigan Ave., Chicago, (1946).
M. Coburn, (retired) 4117 Park Ave., Indianapolis 5, Ind., (1946)
C. M. Colvin, Constr. Supt., Armco Drainage & Metal Products, Inc., 7th & Parker Sts., Berkeley, Calif., (1945).
W. E. Crawford, Pres., George Vang, Inc., 623 Grant Bldg., Pittsburgh, Pa., (1946).
E. T. Cross, V.-P., Armco Drainage & Metal Producs, Inc., Middletown, Ohio, (1946).
T. D. Crowley, Pres., Thos. D. Crowley & Co., 37 S. Wabash Ave., Chicago, (1946).

V. W. Davis, Mgr. R. R. Sales, Armco Drainage & Metal Prod. Inc., P. O. Box 1343, Atlanta, Ga., (1946).
G. E. Detzel, George E. Detzel Co., 2303 Gilbert Ave., Cincinnati, Ohio, (1945).
G. J. Diver, V. P. Morrison Ry. Supply Corp., 814 Rand Bldg., Buffalo, N. Y., (1946).
H. E. Donovan, V. P., T. W. Snow Construction Co., 9 So. Clinton St., Chicago 6, Ill., (1950).
F. J. Duffie, Gen. Supvr., Oxweld Railroad Service Co., 230 N. Michigan Ave., Chicago, (1946).
W. D. DuLac, Dist. Mgr., Pittsburgh Pipe Cleaner Co., 544 New Center Bldg., Detroit, Mich., (1945).

Case History

Problem. An overhead water line used to fill locomotive boilers in a midwest roundhouse was badly clogged with scale. It was impossible to clean the line mechanically because of valves, elbows and varying pipe sizes in the 1,300 foot length. Replacement cost was approximately $3,000.

Solution. Dowell engineers were called on the job. The line was filled with special liquid solvents designed to dissolve and disintegrate the scale deposits. Control checks were carefully made as the work progressed. Dowell furnished necessary trained personnel, chemicals and truck-mounted pumps, mixers and control equipment. The line was out of service only 13 hours.

Results. Railroad officials described the line as 100% clean. The length of time required to fill a locomotive with water from this line was greatly shortened.

Dowell Chemical Scale Removal Service has also proven effective for cleaning locomotive and stationary boilers, underground and surface lines, and for increasing production from water wells.

DOWELL

DOWELL INCORPORATED

Subsidiary of The Dow Chemical Company

Tulsa 3, Oklahoma

New York 20
Philadelphia 2
Boston 16
Wilmington 99
Richmond
Buffalo 2
Cleveland 13
Detroit 2
Chicago 2
St. Louis 8
Kansas City
Atlanta
New Orleans 12
Houston 2
Fort Worth 2

L. T. Ericson, Ch. Engr., The Jennison Wright Corp., Toledo, Ohio, (1948).
H. Eschenbrenner, Pres., Universal Concrete Pipe Co., 36 Ashbourne Rd., Columbus, Ohio, (1946).
F. W. Evinger, R. R. Repr., The Patterson Sargent Co., 1882 S. Normal Ave., Chicago, (1946).

J. D. Faylor, Div. Engr., Armco Drainage & Metal Prod., Inc., 444 Insurance Exchange Bldg., Des Moines, Iowa, (1946).
P. Fields, Sales Div., Detroit Graphite Co., 3228 N. Broadway, St. Louis, Mo., (1946).
A. J. Filkins, Pres., Filkins & Sons, 9 So. Clinton St., Chicago, (1927).
F. Fix, Sales Mgr., Transp. Dept. Cent. Div., Johns-Manville Sales Corp., 1530 Guild Hall Bldg., Cleveland, Ohio, (1946).
L. Flanagan, Detroit Graphite Co., 1500 S. Western Ave., Chicago, (1937).
R. L. Fletcher, Strl. Engr., Timber Engineering Co., 1319—18th St., N. W., Washington, D. C., (1947)
L. E. Flinn, Sls. & Serv. Repr., Dearborn Chemical Co., 310 S. Michigan Ave., Chicago, Ill., (1949).

J. L. Gibboney, Asst. Vice Pres., National Aluminate Corp., 4042 Kessler Bl., Indianapolis, Ind., (1949).
I. L. Glassgold, President, Masonry Resur. & Con. Co. Inc., B. & O. Coal Pier, Baltimore, Md., (1950).
L. E. Goerder, Supt., George Vang, Inc., R. R. Contractors, 623 Grant Bldg., Pittsburgh, Pa., (1946).

E. H. Harder, General Contractor, 809 Page St., Berkeley, Cal., (1950).
H. F. W. Hauslein, Gen. Mgr., H. Hauslein & Associates, 221 N. LaSalle, Chicago, (1948).
W. R. Hedden, Gen. Supt. of Constr., Roberts & Schaefer Co., 130 N. Wells St., Chicago, Ill., (1946).
J. F. Hickey, Pres., Baker & Hickey Co., 85 E. Gay St., Columbus, Ohio, (1946).
W. N. Hoelzel, Sls. Gary Screw & Bolt Div., Pittsburgh Screw & Bolt Corp., 122 S. Michigan Ave., Chicago, Ill., (1949).
T. E. Hoffman, Div. Mgr. & Fire Pro. Supv., The Zone Co., 917 N. Main St., Ft. Worth, Tex., (1949).
F. W. Holstein, Mech. Engr., The Rails Co., 115 Observer Highway, Hoboken, N. J., (1948).
W. S. Hopkins, Jr., M. of W. Repr., Air Reduction Sales Co., Garrett, Ind., (1949).
R. R. Howard, Cent. Div. Mgr., Fabreeka Products Co., Inc., 6432 Cass Ave., Detroit, Mich., (1946).
D. A. Hultgren, Pres., David A. Hultgren Co., 80 E. Jackson Blvd., Chicago, (1945).

A. E. Jacobson, Asst. to Mgr., Oxweld Railroad Service Co., 230 No. Michigan Ave., Chicago, Ill., (1950).
E. S. Joehnk, c/o F. K. Ketler Co., 327 So. La Salle St., Chicago, Ills.
H. E. Johnston, Sales & Ser. Engr., Dearborn Chemical Co., 205 E. 42nd St., New York, (1947)
J. E. Kalinka, Vice-Pres., Roberts & Schaefer Co., 130 N. Wells St., Chicago, Ill., (1946).
B. D. Keatts, Reg. V.-P., Intrusion-Prepakt, Inc., 746 Union Commerce Bldg., Cleveland, Ohio, (1946).
M. G. Kirk, Sales, Pittsburgh Screw & Bolt Corp., Box 1708, Pittsburgh, Pa., (1948).
F. H. Kuhlmann, Dist. Mgr., Dearborn Chemical Co., 1218 Oliver St., St. Louis, Mo., (1946).

J. W. Lacey, Gen. Supvr., The Oxweld Railroad Service Co., 230 N. Michigan Ave., Chicago, (1946).
C. L. LeDuc, Field Sales Mgr., Acorn Refining Co., Cleveland, Ohio, (1946).
F. M. Lehrman, Engr., Reynolds Metals Co. (Ry. Suppl. Div.), 64 E. Jackson Barrington, Ills.
F. Leypoldt, Jr., Pres., Carbolineum Wood Preserving Co., 528 W. Highland Ave., Milwaukee, Wis., (1945).
E. J. Littleton, Mgr. R. R. Sales, Jennison-Wright Corp., Granite City, Ill., (1948).
J. S. Loeffler, Sales Engineer, Armco Drain Metal Prod., Inc., 4345 Lyndale Ave., N. Minneapolis, Minn., (1948).
L. A. Luther, Serv. Engr., Ingersoll-Rand Co., 1121 Hamilton, Palo Alto, Calif., (1945).
C. A. Lyon, Dist. Mgr., Master Builders Co., 228 N. LaSalle St., Chicago, (1945).

The Train of Tomorrow
on VAPOR DRIED* TIES of TODAY

Oak crossties Vapor-Dried and Treated with ten pounds, 30/70 Creosote-Petroleum by Taylor-Colquitt Co. September, 1948.

On The Clinchfield

Vapor-Drying offers you these advantages:

Deeper penetration and better distribution of the preservative.
Reduces losses from checking and splitting.
Complete sterilization of ties and timber—protection against decay.
Smaller inventories—less insurance and interest.
From tree to track in hours, instead of months.

VAPOR DRYING IS TIMBER CONSERVATION

*Process Pat'd

TAYLOR-COLQUITT CO., SPARTANBURG, S. C.
PLANTS: SPARTANBURG, S. C. — WILMINGTON, N. C.

W. L. McDaniel, V.-P., Massey Concrete Products Co., 122 S. Michigan Ave., Chicago, (1945).
E. C. McFadden, Dist. Mgr., Pittsburgh Pipe Cleaner Co., 11110 Longwood Dr., Chicago 43, (1945)
E. J. McGehee, Vice-Pres., Koppers Co., Inc., 122 So. Michigan Ave., Chicago 3, Ill, (1946).
C. A. McTaggart, State Sales Mgr., N. & S. Dak., Armco Drainage & Meal Products, Inc., 705 National Bank Bldg., Sioux Falls, S. D., (1946)
G. McVay, Mgr. R. R. Sales Div., The Ruberoid Co., 307 N. Michigan Ave., Chicago 1, (1937)
D. B. Mabry, Mgr. Lbr. Sales, T. J. Moss Tie Co., 700 Security Bldg., St. Louis, Mo., (1948).
B. J. Many, Pres., B. J. Many Co., Inc., 30 N. LaSalle St., Chicago, (1946).
C. L. Martin, c/o H. P. Martin & Sons, Box 475, Owensboro, Ky., (1946).
C. V. Mero, Mastercraft Tile & Roofing Co., No. 1 20th St., Richmond, Calif., (1949).
F. J. Meyer, Ch. Engr., Ry. Prod. Div., Phila. Steel & Wire Corp., 9 S. Clinton St., Chicago, Ill., (1948).
J. Wallace Miller, Pres., W-M Corp., 608 S. Dearborn St., Chicago, (1946).
J. H. Minton, The Minton Construction Co., 3715 Prospect Ave., Cleveland, Ohio,
H. Montgomery, Dist. Mgr., The Master Builders Co., 1340 E. 6th St., Los Angeles, Calif., (1946).
Z. J. Montgomery, Arco Co. of California, Ltd., 745 E. 59th St., Los Angeles, Calif., (1945).
G. J. Morris, Dist. Engr., Electric Tamper & Equip. Co., P. O. Box No. 5 Cambridge Ohio, (1948).
H. M. Morton, Sales Eng., R. R. Div. Johns-Manville Corp., 1267 Architects Bldg., Los Angeles, Calif., (1945).
H. Mull, V.-P. Sales, Warren Tool Corp., 2119 Bankers Bldg., Chicago, (1946).
J. K. Murdock, Vice-Pres., The Murdock Mfg. & Supply Co., 426 Plum St., Cincinnati, Ohio, (1946).

L. H. Needham, Vice-Pres., The Penetryn System, Inc., 2294 Scranton Rd., Cleveland, Ohio, (1946).
W. L. Norman, Field Engr., Joy Mfg. Co., 2900 Santa Fe Ave., Los Angeles, Calif., (1949).

P. A. Orton, Jr., V.-P., Orton Crane & Shovel Co., 608 S. Dearborn St., Chicago, (1946).

G. H. Paris, R. R. Repr. Strl. Bureau, Portland Cement Assoc., 33 W. Grand Ave., Chicago, (1945).
R. Patterson, Vice Pres., Instrusion Prepakt, Inc., 80 E. Jackson Boul., Chicago 4, (1946)
D. D. Powers, Sales Engr., Dearborn Chemical Co., 1101 Union Central Bldg., Cincinnati 2, Ohio, (1947)

C. C. Rausch, Asst. Vice-Pres., Dearborn Chemical Co., 310 S. Michigan Ave., Chicago, (1945).
G. H. Redding, Pres., Massey Concrete Products Co., 122 S. Michigan Ave., Chicago, (1946).
W. T. Reeves, Const. Engr. Strl. Steel Dept., Robert W. Hunt Co., 172 W. Jackson Boul., Chicago, (1924)
H. E. Robertson, Mgr., The H. E. Robertson Co. Inc., 730 E. Gage Ave., Los Angeles, Calif., (1946).
W. O. Robertson, Div. Sales Engr., Armco Drainage & Metal Prod., Inc., Box 1657, Baltimore, Md., (1946).
O. C. Rome, National Boiler Washing Systems, 80 E. Jackson Blvd., Chicago, (1945).
J. H. Roth, Sales Engr., Buda Co., 492 So. Marion Parkway, Denver, Colo., (1947).
D. A. Ruhl, Sales Engr., Tbr. Structs., Inc., 120 S. La Salle, Chicago, Ill., (1948).

J. M. Scott, The Arco Co., 614 Delaware St., Scranton, Penna., (1945).
J. W. Shoop, Vice President, The Lehon Co., 4425 S. Oakley Ave., Chicago,
F. C. Smith, R. R. Fire Protect. Engr., Marsh & McLennan, Inc., 231 So. La Salle St., Chicago, Ill., (1948).
B. S. Snow, Pres., T. W. Snow Construction Co., 9 S. Clinton St., Chicago, (1946).
C. E. Southwick, Factory Repr. Homelite Corp., (Port Chester, N. Y.), 624 S. Anderson, Los Angeles, Calif., (1945).
G. W. Stlerer, Mgr., Structural Steel Dept., Robert W. Hunt Co., 175 W. Jackson Blvd., Chicago, (1946).

Fairmont

RAILWAY MOTOR CARS
AND WORK EQUIPMENT

Performance
ON THE JOB
COUNTS

One name—and only one—has been exclusively associated with railway motor cars and work equipment for more than 40 years. That name is Fairmont. Today it identifies more than half the motor cars in use—and has come to be synonymous with the slogan, *performance on the job counts.* We will be glad to give you examples of how Fairmont motor cars and work equipment can save time and money for you.

FAIRMONT RAILWAY MOTORS, INC., FAIRMONT, MINN.

W. C. Thatcher, National Boiler Washing Systems, 80 E. Jackson Blvd., Chicago, (1945).
N. Thompson, V-P., Homelite Corp., Port Chester, N. Y., (1946).
R. N. Tracy, Div. Engr., Armco Drainage Metal Products, Inc., P. O. Box No. 2170, Denver 1, Colo., (1946)
F. W. Truss, Mgr. R. R. Sales, Armco Drainage & Metal Prod., Inc., 815 Ambassador Bldg., St. Louis, Mo., (1946).

O. H. Utley, Sales Mgr., The Zone Co., Div. of Southwestern Petroleum Co., 1917 N. Main St., Ft. Worth, Tex., (1949).

R. G. VandenBoom, Pres., Pacific Union Metal Co., 3248 Long Beach Ave., Los Angeles, Calif., (1946).

R. Wagner, Roberts & Schaefer Co., 301 N. Michigan Ave., Chicago, (1946).
W. R. Walters, Gen. Mgr., Railway Ballast Cond. Corp., 1460 Rand Tower, Minneapolis, Minn., (1949).
K. J. Weir, W-M. Corporation, 680 S. Dearborn St., Chicago 5, (1940)
B. E. Whipple, Sales Eng., Pacific Union Metal Co., P. O. Box No. 2616 Term. Annex. Los Angeles, Calif., (1946).
F. T. Winters, Jr., Mgr. Wood Control Div., Pacific Coast Borax Co., Los Angeles, Calif., (1949).
B. R. Wood, c/o The Master Builders Co., 7016 Euclid Ave., Cleveland, Ohio, (1937).

R. W. Young, Jr., R. W. Young Mfg. Co., 20 N. Wacker Dr., Chicago, (1946).

* * *

DOUBLE EXTRA HEAVY

HAND - MADE
TACKLE BLOCKS

- Steel Blocks for wire cable.
- Wood Blocks for Manila rope.

W. W. PATTERSON COMPANY

54 Water Street, Pittsburgh, Pa.

INDUSTRIAL ROOFING—

SPECIALIZING—RAILROAD WORK

INSTALLING NEW SHEATHING and BUILT-UP ROOF ON RAILROAD MACHINE SHOP BUILDING

R. E. FORSHEE CO., Inc.

2119 Dana Ave.
Cincinnati 7, Ohio

The

PENETRYN SYSTEM

Inc.

Restoration and Protection of Masonry

●

SHOTCRETE RESTORATION OF PIERS, ABUTMENTS, DAMS and TUNNELS

●

PRESSURE GROUTING OF MASONRY and FOUNDATIONS

●

ALL PHASES OF PRESSURE CONCRETE CONSTRUCTION

Albany Cleveland Chicago

MEMBERSHIP BY ROADS

(ACTIVE MEMBERS ONLY)

American Railway Engineering Association

N. D. Howard

Association of American Railroads

B. L. Robinson
A. A. Sirel

Akron, Canton & Youngstown R. R.

D. W. Converse

Atchison, Topeka & Santa Fe Ry. (System)

R. D. Bisbee
G. A. Brown
G. Cole
L. H. Davis
W. F. Martens
L. E. May
E. L. Miczanko
E. W. Simpson
W. A. Sweet
C. L. Tanner
R. A. Van Ness

Baltimore & Ohio R. R. (System)

J. T. Andrews
J. H. Babbitt
E. H. Barnhart
J. G. Begley
R. D. Bisbee
C. D. Burrows
E. J. Clopton
L. A. Cowsert
H. D. Curie
W. E. Dwy
F. A. Ernst
W. G. Gillespie
R. W. Gilmore
H. W. Ingram
H. E. Jackman
L. P. Kimball
E. R. McKee
J. G. Miller
J. O. Miller
W. O. Nelson
H. E. Passel
H. M. Potts
W. F. Raley
H. W. Routenberg
F. F. Schilt
O. G. Todd
L. W. Watson
W. M. Wells

Baltimore & Ohio Chicago Terminal Ry.

D. J. Evans

Bangor & Aroostook R. R.

C. E. Garcelon
R. H. Morrison

Bessemer & Lake Erie R. R.

J. E. Yewell

Boston & Albany R. R.

R. V. Wickman

Boston & Maine R. R.

J. W. Gannon, Jr.
J. J. Healy
C. A. Little
E. S. Meserve
H. B. Richardson
F. R. Spofford
E. B. Tourtellotte

Butte Anaconda & Pacific Ry., (Electric)

R. L. Lewis

Burlington-Rock Island R. R.

S. K. Autry

Canadian National System
(Incl. Central Vermont R. R. and Grand Trunk Western Ry.)

L. E. Bergeron
W. T. Brice
N. Dixon
G. R. Fisher
L. M. Frost
H. C. Halliday
F. J. A. Leinweber
G. H. Priest
J. J. Robertson
A. D. Shackleford
C. J. Shapland
C. M. Walker

STOP—Before Repainting

Old Bridges . . . Investigate the possibilities of the Airco Flame Cleaning Process. This use of the oxyacetylene flame removes rust and scale and as it cleans it leaves a warm, dry surface, conducive to a long-lasting paint job.

Before Erection of Bridges . . . Investigate the savings in steel, time and money to be realized from the use of arc welding of structural members in the shop or on the right-of-way. Arc welding, together with gas cutting also can be put to use in general repair work on bridges.

"Write your nearest Airco office for further information."

. . . SERVING RAILROADS FROM COAST TO COAST . .

GENERAL OFFICES: 60 EAST 42nd STREET, NEW YORK 17, N.Y.

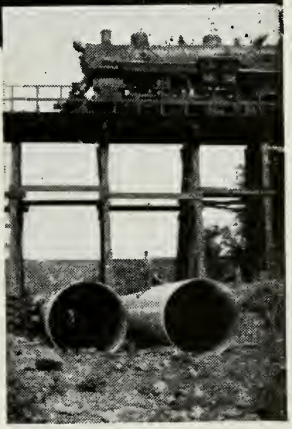
AIRCO

AIR REDUCTION

Air Reduction Sales Company • Air Reduction Magnolia Company
Air Reduction Pacific Company
Divisions of Air Reduction Company, Inc.

Headquarters for Oxygen, Acetylene and Other Gases . . . Carbide . . . Gas Cutting Machines
Gas Welding Aparatus and Supplies . . . Arc Welders, Electrodes and Accessories

Replace Old Trestles This Easy, Low-Cost Way



You can slash maintenance costs and eliminate fire hazards by replacing those tired old trestles with ARMCO MULTI PLATE Pipe.

It is easy to install a MULTI PLATE structure. The pre-curved, corrugated metal plates arrive on the job site ready for quick installation by an unskilled crew. Just assemble, bolt, and then backfill directly against the metal. Only a few days are needed. No curing, no delays, no slow orders.

Plug the leak in your maintenance budget by writing today for complete data on ARMCO MULTI PLATE Pipe. Armco Drainage & Metal Products, Inc., 3935 Curtis Street, Middletown, Ohio.

ARMCO

ARMCO MULTI PLATE PIPE

Canadian Pacific Ry.

H. T. Lord
E. N. Morin
A. Parisien
E. Patenaude

Chattahoochee Valley Ry.

G. W. Neal

Central of Georgia Ry.

G. W. Benson

Central of Vermont Ry. (See Canadian National System)

Chesapeake & Ohio Ry.

W. V. Allen
J. L. Alvord
H. A. Boehling, Jr.
W. W. Caines
J. G. Carlon
Fred Dodson
R. W. Cassidy
C. J. Geyer
C. F. Gilbert
W. R. Graham
P. D. Haines
H. M. Harlow
G. F. Hartman
J. E. Heck
R. L. Hecker
B. J. Howay
M. J. Hubbard
F. G. Hull
F. W. Hutcheson
W. A. Hutcheson
E. B. Jones
P. L. Koehler
R. B. Marshall
O. P. Nicely
C. Perry
P. E. Scites
C. E. Sims
R. P. Wilson
R. M. Vance
C. Williams

Chicago & Eastern Illinois Ry.

R. C. Baker
R. J. Landregan
I. A. Moore
E. D. Rice
A. W. Schroeder

Chicago & Illinois Midland Ry.

N. E. Peterson

Chicago & North Western Ry. (Including Chicago, St. Paul, Minneapolis & Omaha Ry.)

W. F. Armstrong
H. L. Barr
A. E. Bechtelheimer (retired)
F. N. Budzenski
A. A. Colvin
F. W. Creedle
H. H. Decker (retired)
A. H. Deno
L. J. Deno
J. V. Duchac
F. Duresky, Jr.
E. M. Enger
C. G. Friets
L. D. Garis
A. R. Harris
W. H. Huffman
D. H. Johnson
L. R. Lamport
K. Larson
G. A. Linn
R. P. Luck
H. C. Madson
C. R. Malmberg
D. A. Manning
P. B. Merwin
B. R. Meyers
G. Olson
J. R. Penhallegon
L. R. Pennington
O. C. Rhoades
L. C. Smith
P. V. Thelander
E. C. Vandenburgh
J. R. Wenzel
B. M. Whitehouse
W. Wilbur
L. C. Winkelhaus

Chicago & Western Indiana R. R. (and Belt Ry. of Chicago)

J. Ebbens
A. B. Hillman
V. V. Holmberg
L. J. Lieser

Chicago, Burlington & Quincy R. R., Colorado & Southern Ry., and Ft. Worth & Denver City Ry.

R. H. Brandt
E. J. Brown
A. E. Copeland
R. F. Copeland
R. P. Cox
F. H. Cramer
W. D. Gibson
A. Guenther
P. F. Huston
E. W. Moore
W. C. Oest
B. C. Phillips
A. D. Reed
A. G. Reese
L. L. Seley
R. Srb
J. J. Walsh

Bates & Rogers Construction Corp.

General Contractors

600 WEST JACKSON BOULEVARD
CHICAGO

All Classes of Railroad Construction, Grading, Bridges, Tunnels, Track Work, Pile Driving, Dams, Power Plants, Industrial Buildings.

JOHN D. BOLTON & CO., INC.

Gunite Contractors for More than a Quarter of a Century

SPECIALIST IN RAILROAD WORK

OFFICE AND WAREHOUSE
910 Custer Avenue -:- Evanston, Illinois

Telephones
Chicago: AM bassador 2-5876 ● *Evanston:* UN iversity 4-3120

Chicago Great Western R. R.

R. A. Nelson

Chicago, Indianapolis & Louisville Ry.

R. F. Hill

Chicago, Milwaukee, St. Paul & Pacific R. R.

M. A. Bost
I. C. Brewer
I. C. Burch
A. B. Chapman
H. B. Christiansen
K. L. Clark
V. E. Engman
W. E. Fuhr
F. E. Galvin
A. M. Glander
F. F. Hornig
K. E. Hornung
B. O. Johnson
H. G. Johnson
R. W. Johnson
H. H. Kruse
S. E. Kvenberg
C. V. Lund
F. O. McGrew
B. J. Ornburn
R. E. Paulson
G. P. Slagle
F. M. Sloane
G. R. Webber

Chicago, Rock Lsland & Pacific Ry.

W. O. Bruce
C. O. Bryant
D. W. Isaacs
J. S. Langston
R. S. Miller
F. W. Thompson
T. J. Webster
F. J. Wirges

Chicago, South Shore & South Bend R. R.

F. J. Corporan

Clinchfield R. R.

J. M. Salmon

Delaware & Hudson R. R.

M. A. Clancy
W. E. Crounse
J. W. Cummings
O. W. Stephens
J. L. Varker
D. A. Webster
N. H. Williams

Delaware, Lackawanna & Western R. R.

C. T. Kaier

Detroit, Toledo & Ironton R. R.

J. S. Hancock
B. Smart

Duluth, Missabe & Iron Range Ry.

L. Clapper

Elgin, Joliet & Eastern Ry.

F. G. Campbell
A. G. Dorland
A. C. Hoyt
A. C. Johnson
W. G. Mateer
G. P. Lokotzke
S. H. Shepley
H. E. Skinner

Erie Railroad

P. C. Chamberlain
L. Elower
W. P. Korwich
F. W. Lichtenberger, Jr.
W. K. Manning
W. F. Petteys
C. A. Roberts
L. A. Rode

Esquimalt & Nanimo Ry.

A. Hamill

Florida East Coast Ry.

J. H. Morgan
H. Norris
J. W. Welch

Galveston, Houston & Henderson R. R.

H. E. Smith

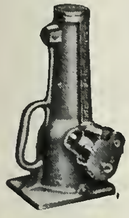
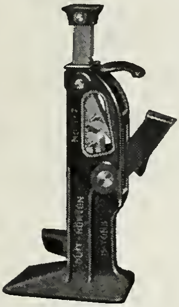
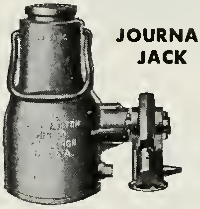
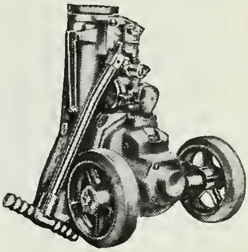
Georgia Railroad

C. E. Phelps

Grand Trunk Western R. R. (See Canadian National System)

Great Northern Ry.

B. Hemstad
T. J. Martin

DUFF-NORTON JACKS

For Every Railroad Requirement

Powerful, safe, economical Duff-Norton Jacks withstand rough, hard usage for all heavy lifting, lowering, pushing or pulling jobs.

Write for Catalog.

BRIDGE JACK

TRACK JACK

JOURNAL JACK

AIR MOTOR POWER JACK

STRENGTH, SAFETY, DURABILITY
DUFF-NORTON JACKS
ESTABLISHED 1883

THE DUFF-NORTON MANUFACTURING CO.

"The House That Jacks Built"—PITTSBURGH 30, PA.

THE WORLD'S OLDEST AND LARGEST MANUFACTURER OF LIFTING JACKS

ROBERT W. HUNT COMPANY
Engineers

INSPECTION – TESTS – CONSULTATION

Cement, Concrete, Chemical, Metallurgical and Physical Laboratories

Inspection and Tests of Structural Steel, Reinforcing Steel and Cement

Supervision of Construction and Field Inspection of Steel and Concrete Structures

Inspection and Tests of Bridge Machinery

Supervision of and Qualification of Welders

Resident Inspectors at the Larger Manufacturing Centers

General Offices and Laboratories
175 W. Jackson Blvd., Chicago 4

San Francisco
Los Angeles
Portland
Seattle
Philadelphia

Pittsburgh
New York
London

St. Louis
Birmingham
New Orleans
Toronto
Montreal

Gulf, Colorado & Santa Fe Ry.

G. J. Bass
G. R. Hunt

Gulf, Mobile & Ohio R. R.

H. Bober
M. D. Carothers
R. D. Hellweg
L. F. Rapier
R. E. Ventress
E. G. Wall

Illinois Central R. R.

W. A. Beringer
M. Block
T. W. Brown
A. E. Burford
W. R. Burke
C. M. Chumley
C. H. Crews
P. H. Croft
H. E. Graham
H. C. Little
G. E. Martin
R. C. Mathis
W. O. Morris
C. H. Mottier
E. L. Parrish
F. A. Reed
C. E. Russell
E. R. Schlaf
E. F. Snyder
H. D. Walker
L. H. White

Illinois Terminal R. R.

L. M. Firehammer

Indiana Harbor Belt R. R. (and C. R. & I. R. R.)

C. A. Smith

Kansas City Southern Ry.

A. N. Reece

Lake Superior & Ishpeming Ry.

A. Wiitala

Lehigh & New England R. R.

G. T. Steidel
H. C. Tunison

Lehigh Valley R. R.

W. P. Clark
H. A. Wistrich

Long Island R. R.

T. W. Pinard

Louisiana & Arkansas Ry.

W. C. Borchert

Louisville & Nashville R. R.

G. R. Sproles
J. M. Salmon, Jr.

Maine Central R. R.

H. J. Aliberti
W. Lampson
R. N. Snow

Michigan Central R.R. (See N. Y. System)

Minneapolis, St. Paul & Sault Ste. Marie R. R.

E. E. Foster
J. P. Gannon
W. R. Jacobson
A. S. Krefting
V. E. Olson
W. E. Pederson

Minneapolis & St. Louis Ry.

J. M. Gustafson

Minnesota Transit Co. (and St. Paul Union Depot Co.)

N. F. Podas

Missouri-Kansas-Texas Lines

C. P. Cummings
V. T. Huckaby
J. E. Wolfe

LUFKIN TAPES AND RULES

CHROME CLAD Steel Tapes—The exclusive Lufkin development—jet black markings on satin chrome white surface, accurate, durable, easy to read. See them at your dealers.

WRITE FOR FREE CATALOG

THE LUFKIN RULE CO.

SAGINAW, MICH. NEW YORK CITY

MASSEY
CONCRETE PRODUCTS CO.

111 W. Washington St. Chicago 2, Ill.

41 Years of Service to American Railroads

SALES OFFICES

New York, 50 Church St.
Atlanta 3, 1104 Candler Bldg.
Birmingham, Ala.

PLANTS

Birmingham, Ala.
Kansas City, Kans.
Wireton, Ill. (Chicago Switching Area)
New Brunswick, N. J.
Melbourne, Ky.

Precast Piles — Bridge Deck Slabs
Culvert Pipe — Relay Houses
Battery Boxes — Wells
Signal Material
Cribbing

Missouri Pacific R. R.

J. L. Anderson
W. H. Begeman
O. H. Blankenship
W. H. Bunge
R. E. Caudle
A. B. Chaney
P. B. Collier
E. F. Cook
B. Cooper
C. R. DuBose
H. E. Ezzel
C. U. Faircloth
J. M. Giles
A. A. Hampton
M. J. Harp
P. W. Hofstetter
W. A. Huckstep
N. E. Hueni
J. J. LaBat
C. W. Laird
W. A. Langford
J. A. Mann
E. L. Mason
L. Mayfield
W. R. Meeks
E. I. Nelson
E. Park, Jr.
L. A. Schaefer
D. E. Schreiber
J. R. Showalter
H. A. Springel
W. B. Starnes
S. R. Thurman
G. Walker
G. P. Walker
H. Wrights

Monogahela Connecting R.R.

W. M. Warso

Nashville, Chattanooga & St. Louis Ry.

S. H. Hailey

New York Central System

A. Anderson
L. E. Benner
H. F. Bird
E. H. Blewer
P. E. Dale
C. Eisele
G. B. Davis
H. E. Davis
J. Galbraith
J. A. Hanson
R. J. Hardenbergh
D. P. Kinzel
C. C. Lederer
J. A. Lewis
H. B. Lorence
J. F. McCay
B. W. Merrill
L. R. Morgan
C. J. Reed
G. E. Robinson
C. R. Taggart
E. E. Tanner
E. R. Tattershall
O. C. Wentling
J. W. Westwood
J. C. White
F. F. Widrig

New York, Chicago & St. Louis R. R.

E. W. Singer

New York, New Haven & Hartford R. R.

B. J. Furniss
J. L. Holmes
H. W. Jenkins
F. A. Kelly
G. M. Ryan
L. J. Tetreault

New York, Ontario & Western Ry.

C. Owens

Northern Pacific Ry.

A. F. Ainslie
R. W. Humphreys
C. N. Overdahl
P. X. Simpson

Ontario Northland Ry.

T. D. Saunders

Pacific Electric Ry.

B. F. Manley

Peoria & Pekin Union Ry.

R. J. Lorber

Compression Rail Anchors

Compression Rail Anchors

With bridge engineers, protection against running rail in *both* directions is vital. That's why you find Compression two-way holding a standard feature on many of the nation's foremost spans.

The Rails Company, 178 Goffe St., New Haven 11, Conn.

Pennsylvania R. R.

T. J. Atkinson
J. J. Brandimarte
W. D. Conrad
F. D. Day
H. R. De Walt
H. M. Dick
W. R. Ganser
H. P. Greene
C. L. Hawkins
C. G. Hill
H. T. Johnson
J. A. Jorlett
W. G. Kemmerer
J. I. Kendall
W. T. League
J. W. N. Mays
W. Mitchell
J. D. Moore, Jr.
W. H. Pahl, Jr.
G. H. Perry
T. W. Pinard
R. G. Preston
C. A. J. Richards
D. C. Todd
J. F. Twomey
W. B. Warfield
R. A. Westergren

Port Everglades Belt Line Ry.

F. J. Stewart

The Pullman Company

C. R. Harding

Railway Age — Railway Engineering and Maintenance

C. M. Burpee
M. H. Dick
N. V. Engman
H. E. Michael
W. L. Turner, Jr.
J. S. Vreeland

Railway Engineering and Maintenance Cyclopedia

R. E. Dove

Reading Company

C. E. Bingaman
W. B. Konkle
F. H. Siegfried
J. W. Stutzman
R. S. Templin
J. A. Walsh
D. E. Weidner

Richmond, Fredericksburg & Potomac R. R.

E. M. Hastings

San Diego & Arizona Eastern Ry.

C. M. Eichenlaub

Sand Springs Ry.

C. O. Nuckolls

St. Louis San Francisco Ry.

A. E. Blaes
A. L. Burleson
S. L. Collette, Sr.
K. Fouts
J. Inmann
V. L. Leak
A. N. Matthews
H. A. Matthews
J. W. McDonald
W. H. Pryor
C. E. Wallace

St. Louis Southwestern Ry.

J. R. Leguenec
W. V. Parker (retired)
J. Summer

Seaboard Air Line Ry.

Y. C. Beam
R. L. Collum
L. M. Hartley
J. V. Inabinet
J. U. Martin
R. L. Norton
C. E. Schofield
J. F. Warrenfells
J. P. Witherspoon
R. O. Zittrouer

For Long-Time Protection against Corrosion

USE NO-OX-ID

NO-OX-ID Rust Preventives, long a favorite with maintenance men for protection of railway structures, guards metals two ways. Forms a protective film to mechanically seal out moisture and oxygen. Contains chemical inhibitors to prevent underfilm corrosion.

Bridge Protection

The life span of bridges can be lengthened by NO-OX-ID coatings . . . No intensive cleaning is necessary. Signal bridges and turntables can also be given this long-term protection.

Tank Protection

Steel water tanks should be coated inside and out with NO-OX-ID to prevent corrosion. NO-OX-ID is available in suitable consistencies for the job condition.

Rail Joint Protection

NO-OX-ID protects rail joints from corrosion. Also acts as a lubricant to prevent "freezing." Outstanding weathering qualities insure long-term protection.

NO-OX-ID IRON RUST

Dearborn
Reg. U. S. Pat. Off.

THE LEADER IN RUST PREVENTIVES
AND BOILER WATER TREATMENT

DEARBORN CHEMICAL COMPANY

310 S. Michigan Ave., Chicago 4 • 807-15 Mateo St., Los Angeles
205 E. 42nd St., New York • 2454 Dundas St., West, Toronto

Southern Ry.

R. L. Fox
R. R. Gunderson
A. C. Jones
R. A. Kelso
G. M. Ketchie
C. L. Moser
C. R. Pritchard
R. T. Rumbold
G. L. Sitton
R. H. Snyder
H. L. Veith
T. M. VonSprecken
R. Wall

Southern Pacific Company

H. I. Benjamin
R. B. Carruthers
T. M. Cawthon
S. L Chapin
G. W. Cobb
J. Conley
M. Cronin
R. DeArmond
H. R. Demmon
J. P. Dunnagan
C. Fest
E. U. Gogl
J. L. Gorrie
C. A. Hackett
E. H. Haase
W. C. Harman
M. S. Harwood
H. R. Herrick
V. W. Hutchings
T. E. Jackson
L. E. Lyon
M. Jarratt
A. A. McDermott
P. F. McNally
F. M. Misch
T. D. Osbourne
M. P. Oviatt
L. E. Peyser
A. Pfeiffer
W. J. Phillips
G. W. Rear, Jr.
D. T. Rintoul
N. R. Robinson
J. R. Safley
P. J. Scherer
F. Shobert
J. Smith
L. L. Smith
W. Stoneman
J. A. Strouss
D. E. Tracy
J. D. Trulove
A. E. Tupper
S. White

Terminal R. R. Association of St. Louis

A. Chinn

Texas & New Orleans R. R.

H. A. Hunt
W. H. Rainey
B. M. Stephens
J. F. Scheumack
N. R. Tucker
J. E. Weatherly, Sr.
W. T. Williams

Texas & Pacific Ry.

H. C. Fronanbarger

Texas City Terminal Ry.

H. O. Wray

Texas & Pacific Ry.

W. J. Savage

Virginian Ry.

J. W. Carter
C. W. Gabrio

Wabash R. R.

J. M. Ericson
F C. Huntsman
R. E. Wait

Western Maryland R. R.

H. C. Aaron
J. L. Dougherty
G. H. West

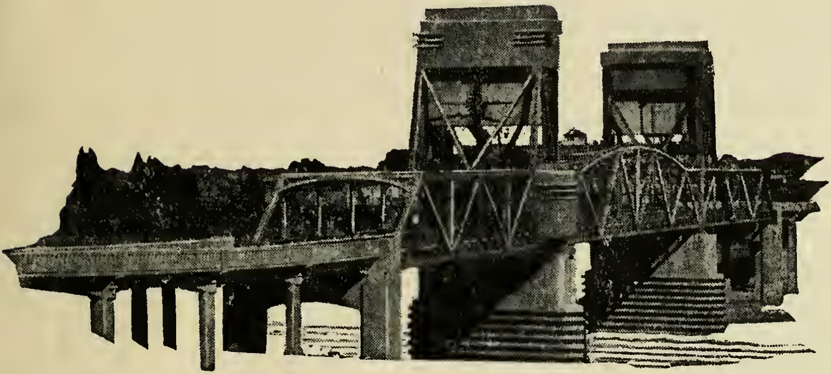
Western Pacific R. R.

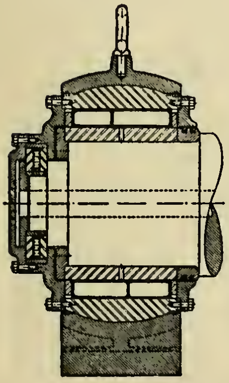
C. E. Elliott
D. G. Hutchinson
G. Switzer
F. R. Woolford

LIST OF ADVERTISERS

Air Reduction Sales Company	85
American Bridge Company	41
American Lumber & Treating Co.	47
Armco Drainage & Metal Products, Inc.	85
Automatic Nut Company	49
Bates & Rogers Construction Corp.	87
Bird & Son, Inc.	53
Bolton, John D., & Co., Inc.	87
Buda Company, The	55
Dearborn Chemical Company	95
Detzel, George E., Company	57
Dowell, Inc.	77
Duff-Norton Manufacturing Company	89
Electric Tamper & Equipment Co.	59
Fairmont Railway Motors, Inc.	81
Forshee, R. E., Company, Inc.	83
Hunt, Robert W., Company	89
Koppers Company, Inc.	45
Lufkin Rule Company, The	91
Many, B. J., Company, Inc.	61
Massey Concrete Products Company	91
Master Builders Company, The	63
National Aluminate Corporation	65
Oxweld Railroad Service Company	67
Pacific Coast Borax Company	69
Patterson, W. W., Company	82
Penetryn System, Inc.	83
Rails Company, The	93
Ric-Wil Company, The	71
Taylor-Colquitt Company	79
Timber Engineering Company	43
Torrington Company, The, Bantam Bearings Div.	Inside Back Cover
Vang, George, Inc.	73
Young, R. W., Manufacturing Company	75
Zone, Company, The	50, 51

SPECIFY TORRINGTON BEARINGS FOR MOVABLE SPAN BRIDGES





Typical are the Torrington Bearings for the vertical lift span of the Lewiston-Clarkston Bridge. Each lift-sheave employs two Radial Roller Bearings, capacity 1,429,000 lbs., and a Thrust Roller Bearing, capacity 170,000 lbs.

Because of the exceptionally high loads encountered, the design and manufacture of anti-friction bearings for movable span bridges present unusual and specialized problems. Torrington's Bantam Bearings Division is thoroughly familiar with this type of bearing application and has successfully equipped a variety of the country's largest movable span bridges. Consult Torrington's Bantam Bearings Division on *your* bearing problems and profit by our wide experience in designing and building to specific requirements.

The Torrington Company • Bantam Bearings Division
South Bend 21, Indiana

TORRINGTON BEARINGS

SPHERICAL ROLLER • STRAIGHT ROLLER • TAPERED ROLLER
NEEDLE • BALL